POISON

THE range of Herr Hugo Glaser's book is very wide, and both in presentation and style *Poison* is not only a valuable contribution to an important subject, but also of extraordinary interest.

Poisons European, poisons indigenous to Africa, Asia, America; poison in plants, animals and minerals; bacterial poisons and poisons manufactured or conveyed by insects—these are but a few aspects comprehensively dealt with by the author. He touches, too, upon the beneficial uses of the many poisons used in medicine as well as the terrible effects of the same substances when improperly employed, and here the author cites well-known cases of individual and mass poisonings.

The inexplicable effects of certain substances on supersensitive persons are also dealt with, whilst habit-forming drugs and their effects are analysed and the varying reactions of animals to some poisons presented and compared with those of human beings. Poisons employed in warfare—from the arrow poisons of ancient times and present-day primitive tribes to the chemicals made use of during the Great War—are also fully described, as well as their deadly effects. Indeed, no substance—if there is anything in its nature which may be reckoned as poisonous—is too exotic or too near home, too ancient or too modern, too rare or too common, too great or too insignificant to find inclusion in this book.

POISON

The History, Constitution, Uses and Abuses of Poisonous Substances

BY

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CHAPTER I

INTRODUCTORY

Rich material for discussion is provided by the type of murder in which poison is used ; it requires a particular kind of mentality, as was observed in 1772 by a criminologist named Schaumann, who was one of the first to publish ideas on criminal psychology. In his book he remarked on the peculiar nature of the woman poisoner, stating that her feelings and thoughts were of so specific a character that only other women, but no men, should be allowed to judge them. Modern students of criminology, psychology and psycho-analysis, however, have the experience of men like Lombroso, Krafft-Ebing, Freud and Wulffen to help them elucidate the type of mind found in women poisoners. The relationship between Woman and Poison is easy to grasp, even though, particularly in classical times, poison was in many cases the man's weapon. " Secrecy and cunning, the qualities required for the planning of a murder by poison, are often attributes of feminine weakness ; Woman is also more capable of dissimulation than Man. Moreover, pleasure in the mysterious and obscure or undiscoverable cause of the terrible consequences is more feminine than masculine ; and the fear of discovery also plays its part in this connection." This was the opinion of Wulffen. But above all it is the sexual background, with its elements of despised love, antipathy for the husband, longing for permanent union with the beloved, which must be looked upon as peculiarly a

feminine domain and which, to borrow a criminological expression, produces murder by poison as a "sexual equivalent."

There is a strange mysticism in poison. And even the scientific investigator here finds himself faced with curious affinities, inexplicable happenings, with riddles the solution of which is manifestly impossible. Biologically speaking, poisoning denotes a chemical relationship, an affinity between the poison and the cell. The cell absorbs poisonous matter with extraordinary readiness, and the combination prevents the cell from fulfilling its function as a useful component of the whole, of the body.

In Goethe's day very little was known of poisons, little more, indeed, than had been known centuries before. Notable advances in chemistry, including toxicology, the study of poisons, were not made till the last years of his life. He died tormented by heart attacks, without the relief of morphia; for at that time the effects of poisons on the body were unrevealed secrets. They are still mysteries to a certain extent, but some of these effects are now known. Remarkably enough, it is the study of bacteriological toxins that opened up the way to these discoveries. Poison is something that is drawn to one or other of the groups of cells essential to life; it is a type of love, but one that brings nothing but misfortune.

One poison may be attracted to the cells which make up the nerve centres, another to those of the respiratory organs, a third to the cardiac cells; yet another seeks combination with the red blood corpuscles or with one of their component parts—e.g. haemoglobin—in order to form a new substance.

It is an irresistible attraction which drives these cells on the one hand and poison on the other to their combination, but the effect is to paralyse the life force in the cells. Only when they are free and unhindered can they fulfil their purpose of serving the whole, can they preserve themselves. But when a particular poison beckons they are compelled to respond. Science speaks of chemical affinities, but the same thing might be called love of an unworthy object, love of something fatal. Healthy life is destroyed—as in other cases—under an inexplicable will-destroying attraction.

The mysticism pertaining to poisons has its roots in the identification of poison-draughts with love-potions—in the Past and possibly even in the Present. Poison : in Latin, *venenum ; venerari*=to honour—Venus. The derivation is too clear to be ignored ; and if we wish to regard it so, the first poison of which we have any record, the apple that Eve gave to Adam in Eden was an apple of love, imbued with the intoxicating poison of its parent tree. That is only a symbolical interpretation. But the ancient world and the Middle Ages possessed a multitude of love-potions, and superstitious people believe in them to this day. Horace refers to them, likewise Juvenal, Plutarch, Ovid, and many others. In many cases they were useless, innocuous concoctions ; but sometimes they were dangerously effective poisons. Spanish fly, for instance, has been regarded as an aphrodisiac from the earliest times. It is still sold by druggists and has often caused severe inflammation of the kidney. Belladonna, the deadly nightshade of our woods, henbane, stramonium and mandrake were for centuries used in love-potions, as a means to excite the sexual feelings of the partner

and reduce resistance. Subsequently severe penalties were imposed for these practices—crucifixion, throwing to the lions, breaking on the wheel. Guilty and innocent succumbed to the love-potion and fell victims to the Law.

There is no doubt that formerly the drinking-vessel was the commonest vehicle for poison. It was one of the chief duties of the lady of the house to prepare refreshing beverages and taste them before they were offered to the guest; sleeping-draughts, also, were very common. In these circumstances the insinuation of small quantities of poison was an easy matter. Poisoned food came next. The methods available continually increased in number, murders by poison became common and mistrust grew in proportion. Not without reason did many people have food tasted by a slave or servant or some other person before eating it. Cardinal Richelieu, who had good cause to fear being poisoned, always threw a scrap of his food to his cats before his meals.

A great deal is also known about some curious ways of administering poison. Eastern fairy tales sometimes tell of poisoned bunches of flowers that instantly killed anyone who breathed their perfume. Science can offer no explanation for these stories, and we are left to wonder what kind of poison it might have been. A more common occurrence seems to have been the sending of poisoned letters: Pope Alexander VI asserted that Caterina Sforza wished to remove him in this manner. Also, one sometimes reads of poisoned shirts: Hercules' shirt of Nessus was the first reported case of this kind. Later similar stories were often related. It is probably true that shirts soaked in a

solution of arsenic and worn for a long time really did cause poisoning—a change of shirt used to be much rarer than a case of poisoning !

Poisoned weapons—arrows, but also spears and daggers—with their double effect as weapons and as poison-carriers have played a considerable part in history ; poisoned forks and table knives have been known to occur. Then again, there were rings furnished with tiny poison containers and needles, which, as if by accident, inflicted a scratch when the owner shook hands—a fatal hand-clasp characteristic of the spirit of the age. Then there were the well-poisoners. The ancient Romans disdained such methods of war, but they were tolerated in the Middle Ages. During the siege of the small town of Tortona (1155) Frederick Barbarossa on his way to Pavia had the springs poisoned that provided water for the town ; and in accounts of subsequent wars we constantly hear of poisoned wells, i.e. springs. Even in the accounts of the Russo-Japanese War similar references are found. Much of it is certainly untrue, much that was considered well-poisoning was due to epidemics, to the spread of some infectious disease in the form of a pestilence ; but even so, a great deal of undoubted poisoning remains. The practice was not adopted in the Great War—poison gas was found more satisfactory.

Innumerable stories could be told of the great men who made a masterly use of poison, and of those who died of it in torment. It is impossible to name them all. That would mean dissecting the entire history of the world : we should have to tell of the Ancient Greeks, dwell at length upon the Roman emperors and empresses, mention many of the Hohen-

staufens and Hapsburgs ; we should have to write long chapters on the Italian families, on the Viscontis, the Sforzas, the Medicis, Scaligers, Farnese, Gonzagas and many more : we should have to write an entire book about the Popes of that period and about the Borgias : much would have to be told of the history of the French kings in the eras of the great mistresses ; of Sultans and Grand Viziers ; of many a Persian Shah ; of Eastern princes ; of Ivan the Terrible and many occurrences at the Imperial Russian Court. The list would be endless. History might be made to disclose a whole army of poisoners of both sexes, some actuated by the lust for power or for self-indulgence, others by love, jealousy or hatred. And even the great names of history only represent a fraction of the whole. Many are well known, but far the greater number are not ; legions of poisoners' victims died obscure deaths and are now lost for ever in oblivion.

The discriminating action (relatively) of poisons has already been mentioned shortly, but there is much that might be said on the subject.

This is most easily understood by calling to mind the principle of *similia similibus*. Measured by the standard which comes most natural to us, i.e. of a human being, many animals possess an almost incomprehensible immunity to poison. A great many examples exist of the tolerance exhibited by certain classes of animals towards the most deadly poisons. (In our eyes poison is a substance harmful to Man.) In the Tropics the mongoose, a member of the family *Viverridae*, is treated as a domestic animal because it does battle with poisonous snakes and even hunts them out ; it is impervious to the poison fang which kills

the most powerful animals such as horses and buffaloes with lightning rapidity—to say nothing of human beings. It is also well known that the hedgehog enjoys an encounter with the adder, poisonous as it is to us. It is partial to adder's flesh as food and swallows the adder's head, including its poison fang. It finds Spanish fly almost as harmless. Again—snails and insects are often to be found contentedly lingering on many poisonous plants such as wolf's milk. Snails, by the way, tolerate several kinds of poison, even small quantities of strychnine. The hundredth part of a gram of atropine, the poison found in deadly nightshade, is sufficient to cause death to human beings; to exterminate a rat, however, a whole gram is needed, and chickens are almost entirely insensitive to this powerful poison.

Human reactions to poison are even more interesting than these examples. It is well known that one can accustom oneself to certain poisons, such as alcohol, nicotine, cocaine and morphia, even though it becomes manifest in the process that everything in the world, pleasure not excluded, must be paid for—morphine and cocaine addiction are high prices to pay. . . . A parallel case is provided by the Styrian arsenic eaters, who tolerate extraordinarily large doses of arsenic. They take this drug mainly with bacon and spirits, and apparently suffer no ill-effects; but they must always continue once they have become accustomed to it. The longing for poison forms a long chapter in the history of man and man's suffering, and it is interesting to note that all over the world people succeed in discovering some intoxicating drug, however carefully Nature may have hidden it: in this respect

Man appears to possess a limitless ingenuity and skill.

In no part of the world, however, do we find a demand for bacterial poisons : they never belong to the habit drugs, although in general they resemble any other form of poison. The smallest quantities are sufficient to produce extensive destruction. Some people are struck down, others are passed by, for they are protected, immune. This may be because they have already encountered this poison and have acquired antitoxins in the blood. Alternatively, their immunity may be congenital—a priceless legacy.

The foregoing is easy to understand. But inexplicable is what is called allergy, that is, a particular sensitivity towards a certain thing, something that may be totally harmless for everyone else, but acts as poison on a particular individual. Even a thousand years ago some inkling of this must have been perceived, for Lucretius Carus says : " What agrees with one man is deadly poison to another." The best known of these conditions is the skin disorder called urticaria (nettle rash), pink or white raised bumps, which can be large or small and which in some cases cause severe itching or considerable swelling, while in others they may disappear again quickly without having caused the patient any annoyance. It is a rash that a doctor recognises at a glance, though its cause is much harder to find and sometimes defeats the cleverest medical investigator Strawberries, shellfish, sardines and many other preserved foods are the best-known offenders ; in other cases, however, the cause must be sought further afield and sometimes escapes detection altogether.

In point of fact, everything that one eats, every

thing with which one comes into contact—not only the stinging-nettle from which the name nettle-rash is derived—may conceivably induce such symptoms ; it is surprising, for example, how many people cannot tolerate even a single spoonful of milk ; these people, or rather their body-cells, have entirely forgotten the beginning of their existence—a piece of ingratitude it would be hard to surpass.

There is a large number of skin diseases whose origins used to be considered so unfathomable that attempts to discover them had practically ceased, but which are now gradually emerging when regarded from this new point of view. The work of Urbach, the Viennese specialist, deserves particular mention. An example : a child suffers from an irritating rash known as prurigo. In hospital he quickly recovers and is discharged. The rash quickly returns ; hospital once more. Once again speedy recovery and discharge. He soon returns again, suffering from the same symptoms. The performance is repeated. Where does the cause lie ? Clearly at home ; but where ? At last it occurs to someone that the child cannot tolerate the sea-grass with which his mattress is stuffed ; it happens to be poisonous to his skin, and hence to his whole body. These are not fantastic theories but proved facts. A little of the sea-grass under suspicion is diluted and the solution injected into the child's skin ; soon after, the same eruption is observed in the region of the injection. Similar tests are frequently made, sometimes with a number of substances until the right one is found.

Certain other diseases, such as hay fever, belong to the same group. When the grass is producing its pollen

this disease flourishes and the victims suffer accordingly. But which grasses and which plants are we to blame? We are only at the beginning of our investigations; but the method is the same as before. There have been many successful attempts to de-sensitise sufferers from hay-fever by injecting extracts of pollen; it is essential, however, to start the treatment in good time before the spring.

The same applies to hay asthma. Some hospitals have special wards for these patients. The air in them is introduced through very tall chimneys and comes from a height where no pollen is brought by the wind.

Other substances besides pollen can precipitate attacks of asthma, just as in the case of nettle-rash. A boy sufferer experienced his first attacks during the summer of a certain year in which he had spent much time in the stables. Every possible extract was injected until it was found that horses' dandruff had induced the asthma; it was then possible to predict that the attacks would not occur so long as this element in the child's environment was eliminated.

Almost every drug has a Janus head: one face shows the Hippocratic facies of Death, the other the mild countenance of Æsculapius the health-bringer. Between the two poles of therapeutic efficacy and fatal action there is often only a small intervening region and this should also be avoided. The list of substances, known as poisons on the one hand and treasured for their curative properties on the other, is extremely long. Among them are: digitalis, the effective cardiac drug, extracted from the leaves of foxgloves; atropine, produced from deadly nightshade; opium, the juice of the unripe poppy capsule; cocaine, the amazing

product of coca leaves ; Spanish fly, the blistering cantharides ; compounds of mercury, in particular the sublimate ; arsenic—the " female poison," as someone once named it—which reappeared some years ago as a pharmacological triumph in the form of salvarsan ; strychnine, the active element of *nux vomica :* phosphorus, the poison which, administered in cod liver oil, cures so many children of rickets—and a hundred more. " Guarded and tamed by doctors' skill, poisons to Man bring good, not ill " ; or, as Goethe once said in a conversation with Wieland : " There is no such thing as poison, it all depends on the dose."

CHAPTER II

ILLUMINATING GAS

It is surprising to note that through the ages there have been changes in the popularity of poisons. At one time the hemlock cup was the most favoured, at another the venomous snake, subsequently arsenic. Now illuminating gas appears to be "in fashion."

It is, of course, not strictly correct to use the word "fashion" in this connection; nevertheless the choice of suicide media makes up one chapter in the tale of the many things in the world known to be subject to eternal flux. In any case, since the Great War, it has happened much more frequently than before that the desperate have chosen to end their lives with the help of gas, which makes it permissible to designate this as their "favourite" method for the period under consideration—a sorry distinction!

This popularity is not hard to understand. In a pathological period in which suicide reaches epidemic proportions, the gas jet appears as a cheap and practical instrument, quick to hand and needing less courage to direct than the pistol used in Werther's day; and the greater the number of gas consumers, the greater—for a time at least—must be the number of those to whom in a moment of despair the thought occurs of opening a gas tap to hasten their relief. Moreover, the semi-desperate—and there are large numbers of these unfortunates—who see in attempted suicide rather than in suicide proper a possible way out of an uncomfortable situation, are the more inclined to make use of gas

because they know how slight the effects are, should a rescuer arrive in time to turn off the tap and open the window. For, if the rescue comes quickly the results are not very serious ; a little headache, slight dizziness and nausea—symptoms which soon disappear with the advent of fresh air. If there is no interference, however, and the atmosphere becomes more and more charged with the gas, the dizziness turns to a profound unconsciousness, from which there is often no awakening. Even if a person who has been severely gassed is still alive when discovered and if everything is done to help him, this powerless condition and loss of consciousness can last for some time, many hours, even days, before death intervenes or life gradually creeps back.

The effect of illuminating gas on the organism is not merely a question of deprivation of air (or rather oxygen), but of a specifically toxic action. The poisonous element of illuminating gas is carbon monoxide. Such poisoning must therefore be classed with poisoning by coal vapours (from burning coal), by water-gas and by fire-damp (mine gas). It is well known that illuminating gas is obtained by the dry distillation of carboniferous substances, that is to say mainly coal, lignite, wood, petroleum waste and peat ; and since these substances contain unequal quantities of carbon, their carbon-monoxide content—and hence their toxic strength—also varies. Good coal gas contains about 5 per cent carbon monoxide ; the percentage increases considerably with the decreasing quality of the material employed and wood-gas often contains more than 30 per cent.

The poisonous action of carbon monoxide has long been recognised, but more precise knowledge as to the

nature of this action has only been obtained during the last few decades. We are now in a position to state positively that carbon monoxide is one of the blood poisons—those remarkable poisons that kill men and animals by bringing about changes in the blood. It is always some chemical affinity that determines the good or bad action of a chemical substance on an organism. The entire subject of chemo-therapy, the search for remedies of all kinds for the most varied diseases, resolves itself into an investigation of chemical affinities.

One of these affinities—fatal to man—is exemplified in illuminating gas, i.e. in the carbon monoxide it contains. The carbon monoxide combines with hæmoglobin, and as the latter is the carrier of the oxygen needed for respiration it is clear that the consequences must be terrible when, on some unhappy night, a human being inhales gas with every breath ; more and more oxygen carriers are deprived of their function, and the blood passes through the gradually failing heart to every part of the body, laden, not with vitalizing oxygen, but with carbon monoxide. There follows what one might call internal asphyxiation, a slow suffocation due to lack of oxygen, the main fuel of life.

This combination of carbon monoxide with hæmoglobin is characteristic of poisoning by illuminating gas and of all carbon-monoxide poisoning. No other form of poisoning produces blood of such a light red colour. Doctors carrying out a post-mortem immediately observe the characteristic hue of the *livores mortis*, and the general rosy colour of the corpse is often by no means suggestive of death, but rather of the flush of sleep. These signs disappear quickly, however, and an examination of the blood is the only

remaining method by which the cause of death can be ascertained. The changes in the blood may still be discernible after several days. They can be detected either by the spectroscope, or by chemical analysis, several processes of which are suitable for the purpose.

Illuminating gas affects all living creatures whose blood is the vehicle of internal respiration, not only of human beings ; and it is worth mentioning that it is now often used to kill animals that are to be dissected after experiments such as gland-transplantation.

Coal-gas, then, is exceedingly poisonous : one-half per cent in the air of a room endangers life ; two per cent causes certain death. It is immaterial whether the actual cause of death is the incapacitation of the hæmoglobin by carbon monoxide, as just described, or whether the carbon-monoxide-hæmoglobin compound thus formed has a specific action on any organ essential to life, on certain centres of the brain, for instance. It is an argument in favour of the latter possibility that after severe but not fatal cases of coal-gas poisoning phenomena may be observed in the brain, such as paralysis, mental derangement and other manifestations, suggesting that small portions of the brain have been injured.

Gas poisonings, since the War at least, are mostly cases of suicide. Gas is available to all classes and to people of all ages, and it is noteworthy that people from the humbler walks of life, women and particularly girls, turn most readily to coal-gas when they feel that they have had enough of life. This explains why most gas suicides take place in the kitchen, which, in humbler dwellings is often the only room furnished with gas, or in the bathroom in more well-to-do houses.

These unhappy people are found, sometimes sitting in arm-chairs, some stretched out on a mattress on the floor, and others in the bath ; and the open gas tap or the gas pipe shows what has happened. Some people, usually men—and this more often in cases of double suicide—employ special devices to achieve their purpose : they improvise long pipe-lines to bring the gas from the kitchen into the bedroom, bore holes through doors and walls in order to bring the tube up to the bed on which they wish to die. Sometimes they pin notes on the front door with the warning " Beware ! Gas ! " so that no other person shall be injured by, say, striking a match, and causing an explosion. Not all of these unfortunates, however, are so careful and some very sad additional tragedies have been caused where the gas has penetrated to a neighbouring room and killed an unsuspecting sleeper.

As already mentioned, the greater number of deaths by gas are certainly suicides ; but a fair number are caused by accident, and it is natural that this number increases with the number of gas-consumers. Gas may escape through faults in the pipe system, fractures, leakiness—or because someone has knocked against a loose tap or a loosely attached pipe in passing. Even more often avoidable carelessness causes the accident. And this in spite of the characteristic smell of coal-gas, which often betrays it, even when only small quantities are present in the air. If only one-hundredth per cent coal-gas (a fraction of the fatal dose) is present in the air of a room, it is usually readily perceived ; but some people are comparatively insensitive, and when the accident occurs to a person just passing into sleep the normal smell of coal-gas ceases

to act as a warning, drowsiness is transformed into unconsciousness and unconsciousness into death. The most tragic of gas-escape accidents are, of course, those in which unsuspecting persons become victims of gas poisoning in homes that are not even furnished with gas. It sometimes happens that somewhere underground a gas main breaks and the gas permeates through the earth and walls, slowing losing its smell and finally poisoning someone who is entirely unaware of the danger even when the first symptoms—headache, dizziness, stupor—set in. Indeed it would be surprising if thoughts of gas were to occur to one whose sole illumination is the humble oil lamp. Accidents of this type, which are often fatal, are among the most insidious and gruesome that can happen.

As may be imagined, attempts have been made for some time past to make such accidents and suicides by gas impossible. The simplest way would be to detoxicate the gas, to manufacture a gas containing no carbon monoxide, for this component is not essential for purposes of lighting and heating. No practicable method of achieving this has been evolved, however. Successful attempts to withdraw carbon monoxide from coal-gas and render it harmless have certainly been made. One method was discovered by Bronn-Linde ; the gas is first liquefied by cooling, so that on account of its low boiling-point the carbon monoxide alone remains gaseous, and can easily be separated from the remaining coal-gas. The " gas "—it is actually no longer gas—which has now become non-poisonous, is then evaporated once more and restored to its original condition.

By this process the gas is also rendered water-free,

which has the advantage of preventing it from freezing in extreme cold. The carbon monoxide present in coal-gas can also be rendered harmless by other means. It can, for example, be transformed by the Cedford process into the harmless substance methane, in which case the presence of a catalyst—a chemical assistant, as it were—is necessary ; its mere presence suffices. The Viennese physicist, W. J. Müller, also uses a catalyst, iron oxide activated by alumina, to destroy the carbon monoxide ; hydrogen and carbon dioxide are formed, and the carbon dioxide must then be separated from the illuminant.

There is a biological method of detoxicating coal-gas, which is of particular interest. It was originated by Professors Fischer and Lieske. They discovered that certain bacteria found in urban sewers possessed the property of decomposing carbon monoxide and slowly transforming it into methane and carbon dioxide. Under specific favourable conditions and at a temperature of 25° C. these bacteria become more active and the process is accelerated. There are other processes that serve the same purpose and have the same disadvantage of increasing the price of production, thus impeding their application.

For the foregoing reason a great number of experiments has been directed towards making the smell of coal-gas stronger, so that it may give a still clearer warning. It is probable, incidentally, that during the last few years, with the production of coal-gas by more economic processes, its smell has been minimized and its carbon-monoxide content—that is, its toxic quality —increased. Many methods of intensifying the smell of coal-gas—of odorising, of scenting it—have been

tried. Mercaptans—compounds of hydro-carbons with sulphur, possessing penetrating odours—have been used for this purpose, also camphor, musk, oil of mustard, " blau "-gas (named after its discoverer), and a variety of strongly scented substances. Professor Grassberger, who has conducted lengthy researches on this question, using the coal-gas supplied by the Viennese Municipal Gas Works, has arrived at the conclusion that only carbialin and light oil forerunnings, or a mixture of both, are of any practical importance in the odorising of this gas ; but this might not apply to the products of other methods of manufacture. Carbialin was suggested by experts many years ago. It is a liquid hydrocarbon which retains the horrible, penetrating smell of oil gas, from which it is obtained by compression. Light oil forerunnings are similarly odorous. These substances, separately or mixed, have proved the most efficacious in experiments carried out under the most varied conditions ; in an ordinary living-room, in a room where onions were being fried and in a kitchen where cauliflower was being cooked. The smell of the coal-gas thus odorised was quite startling and could not be disguised by the food smells. As these substances are by-products of the gas industry, they are cheap and consequently well-suited for the purpose. Their use might avert many accidents and prevent much suffering ; but it cannot reduce the numbers of those who resort to the gas-pipe to end their own pain.

The history of coal-gas poisoning is naturally still young. But from time immemorial the action of coal smoke, the deadly effects of carbon monoxide have been widely known—for example, in the palaces of the

Roman Cæsars. Nero caused his wife, Octavia, to be killed in her bath by coal smoke. Constantine is reported to have done the same to Fausta. Cicero mentions the death penalty by coal smoke ; and in later times this method was also freely used. Mass murder by carbon monoxide is also known to history. Livy reports that after the battle of Cannae the mutinous officers and citizens of Capua were shut up in the baths and killed by the smoke arising from red-hot coals—a political mass-murder, no rare occurrence in disturbed times, but notable on account of the method employed. Incidentally, Hannibal used the same means to kill the inhabitants of Nuceria. He had persuaded them to leave the town and then drove them into baths specially erected for this purpose.

Death by carbon monoxide from charcoal fumes has, then, been known from ancient times, but murders in which this method is practised have now become rare, and suicide by means of the coal brazier is not so common as it was formerly ; the gas jet is simpler. Nevertheless, we still occasionally find suicides using a brazier or the closed outlet-pipe of a stove. Fatal accidents caused by carbon monoxide—catastrophes affecting whole families—are unfortunately very frequent, for carbon monoxide is always produced where there is incomplete combustion, that is to say, from an infinite variety of possible sources.

There is the ordinary open coal-fire in the first place—or again, the open coke stove often used for drying a recently plastered room ; forges and the like where an open fire is needed ; flat-irons heated on glowing charcoal, and even the smouldering wick of an oil-lamp, all these are accompanied by the formation

of carbon monoxide and often lead to poisoning and death. The motor car must not be forgotten ; the exhaust fumes are rich in carbon monoxide and woe to the driver who forgets this and leaves the door of a small lock-up shut and his engine running. Further, there are still many stove dampers in existence which, if left closed, may lead to fatal accidents.

The phenomena attending acute carbon-monoxide poisoning with swiftly ensuing death are the same as those described for fatal cases of poisoning by coal-gas. But chronic poisoning deserves special attention. It is impossible to ascertain how many housewives, servants and other persons suffer from it. It is quite likely that many disorders often grouped together as " nervous disorders " such as headache and other everyday ailments, particularly women's headaches, are in some way connected with chronic CO poisoning. Deep fainting-fits, accompanied by paralysis, cramps and suspended respiration, point almost unmistakably to carbon-monoxide poisoning. But the more trivial symptoms, slight headache and pallor, dizziness and the like, may be easily overlooked ; particularly if they are recurring they are apt to be considered as inevitable everyday evils.

In the Great War, during which the chemists of all countries were able to test the potentialities for war of all the existing gases as well as devising new ones, carbon monoxide was discarded ; and with very good reason. Considerable concentration is needed if it is to act effectively as a poison ; and much smaller quantities of chlorine, phosgene and mustard gas were found to be sufficient. Moreover, carbon monoxide is only slightly less dense than air, so it did not sink down

so easily into the enemy trenches and dug-outs. Further, the internal pressure is too high at ordinary temperatures, which makes the handling of the projectiles unsafe. In short, no use could be found for carbon monoxide in the War, although it has one excellent fighting quality : namely, the inconspicuousness with which it attacks and destroys its victims. And yet there were a number of deaths from carbon monoxide during the Great War : the gas is evolved when shells explode and when guns are fired and there were some cases of poisoning from these causes—several occurred, it is said, on one occasion on an English battleship. But, except in cases like these, carbon monoxide plays no part in the sad history of poison gases in the War.

CHAPTER III

GAS WARFARE

Mingling with the thunder of exploding shells and the din of shrapnel the sound of a gong is heard, not the dinner gong, but a gas warning ; and the cry of " Gas ! " goes up in the trenches and dug-outs ; steel-helmets clatter to the ground and gas masks are put on with fearful speed. Sometimes they have to be worn for many hours, and then at last the menace is over and one can breathe the fresh air again.

But sometimes there is no warning bell. Then Death creeps up with insidious horror—unobserved, unsuspected, but none the less certain. The men die, and there is nothing peaceful about their transition—they suffer the most excruciating agony. This is Remarque's description :

> " They had no chance of envisaging the fate that awaited them. We come to a dug-out ; the men lying there have blue faces and black lips. In one shell-hole the victims had taken off their masks too soon ; they did not know that the gas stays longer at a lower level and, seeing others above them without masks, they tore off their own with the result that they inhaled enough of the poison to scorch their lungs. Their condition is hopeless —struggling with attacks of hæmorrhage and asphyxiation they choke to death."

No country would admit to having been the originator of chemical warfare, of those deaths by gas, the most terrible of all the terrors of war. There was

a negative struggle for priority, but, as a matter of fact whoever was the first person to think of gas in connection with the Great War might have referred to examples in much earlier battles. Since the days of the famous "Greek Fire", attempts have constantly been made to attack the enemy by chemical methods. It is worth noting that in recent times it has been mainly the pharmacologists who have used their knowledge and imagination in the service of patriotism. They devised gas bombs and the like, and having passed their discoveries on to those in command, in many cases suffered the usual fate of inventors—gained little recognition and were soon forgotten.

Thus it happened in the French Revolution, then again in the Prussian wars against Napoleon, and later in the Franco–Prussian war, and on many other occasions. Bonnot's band of apaches who caused the French gendarmes so much trouble in 1912 may still be remembered. They made a garden pavilion into a small fortress which seemed impervious to attack. The Municipal Laboratories of Paris then placed gas shells filled with ethyl bromo-acetate at the disposal of the police, and this led to the defeat of the apaches.

It is improbable that the French had forgotten this when they entered the War two years later. It is certain that at the beginning of the War the Germans never contemplated the use of poison gas, and there is good reason to believe both that they first utilized it some months later than the Allies and that it was a long time before they made up for the delay. Subsequently German technicians became dominant in this field until the last year of the War, when the Americans joined in the gas warfare with great effectiveness.

At the beginning of the War the French pioneers went into action with the shells that had been tested against the apaches at Choisy-le-Roy. In August, 1914, they already had 30,000 of them ; although the ethyl bromo-acetate was only used as a lachrymator at first, it was but a short step from here to the well-known employment of poison-gas proper. On 1st March, 1915, the German war bulletins stated, " at a certain point on our front the French, as on an occasion some months ago, have once again employed projectiles that on explosion give out evil-smelling, suffocating gases."

This was only the beginning ; but the great chemical war was on its way and was destined to progress with terrible speed. Methods of gas warfare can be divided into two clearly defined classes : one method is to distribute the gas by discharging it from cylinders as cloud gas (" blowing " method), the other is to use projectiles such as shells. The use of tear gas and other gases designed to harass and disorganise the enemy need not be discussed at length here, since they are relatively unimportant in comparison with true poison gases.

About the middle of April, 1915, according to Hanslian, a German deserter informed the English on the Flanders front that a gas attack was being planned by the Germans. The English were particularly skilled in examining prisoners, but this was a deserter and his story was not taken very seriously. Gas attack, indeed ! . . . It was nevertheless referred to, though sarcastically, in the orders for the day, and this was the reason for the sudden appearance one day on the parapet of the English front-line trenches of large placards with the scornful legend : " You can wait a long time for the right wind." Things turned out

contrary to expectation, however, and the right wind came very soon.

April 22nd, 1915, is one of the historical dates of the Great War ; it was then that the first big gas attack took place between Bixschoote and Langemarck. The effect was catastrophic. Field-Marshal Sir John French made the following report :

> " Following a heavy bombardment, the enemy attacked the French Division at about 5 p.m. using asphyxiating gases for the first time. Aircraft reported that about 5 p.m. thick yellow smoke had been seen issuing from the German trenches between Langemarck and Bixschoote. The French reported that two simultaneous attacks had been made east of the Ypres-Staden Railway, in which these asphyxiating gases had been employed.
> What followed almost defies description. The effect of these poisonous gases was so virulent as to render the whole of the line held by the French Division mentioned above practically incapable of any action at all. It was at first impossible for anyone to realise what had actually happened. The smoke and fumes hid everything from sight, and hundreds of men were thrown into a comatose or dying condition, and within an hour the whole position had to be abandoned, together with about 50 guns.
> I wish particularly to repudiate any idea of attaching the least blame to the French Division for this unfortunate incident."

Victor Lefebure in his book, *The Riddle of the Rhine*, says :

> " Unfamiliarity amongst the troops, or the staff, for that matter, created an atmosphere of unparalleled confusion. Men attempted to protect them-

selves by burying their mouths and nostrils in the loose earth. . . . We cannot ignore the fact that the morale must have been severely shaken locally, and that general disquiet and uneasiness must have penetrated the whole front."

Fifteen thousand were poisoned by this gas attack, of whom 5000 were killed.

The gas used on the occasion just described was chlorine, the propelling force was the wind. Chlorine, as one learns at school, is a highly mobile yellowish green poisonous gas with a suffocating smell. Its toxicity and the fact that it is easily liquefied by compression render it suitable for war. A small cylinder containing 20 litres of liquid chlorine produces 6000 litres of the gas. As soon as the pressure is withdrawn the liquid is immediately re-transformed into gas and, like a cloud, is slowly driven forward by the wind ; then, since it is heavier than air, it gradually sinks to earth, inflicting terrible injuries on the lungs of anyone who inhales it. Even small quantities of chlorine in the air breathed produce injuries which last for a very long time, and death from chlorine poisoning may ensue within a few minutes. The attack at Bixschoote amply demonstrated the powers of this gas.

The technique of the attack was by no means simple. It was carried out by the regiment under Peterson, which had to bury 1600 large and 4000 small containers in the ground. Each cylinder was about a metre in length. Lead tubes, closed by valves which had only to be opened, connected the cylinders with the surface ; but, as the English said, they had to wait till the right wind was blowing. This was the most important point in all gas attacks in

which the cloud method was adopted ; if the wind changed the weapon was turned against the aggressor and did its work with the same relentless efficiency.

The Germans' gas attack on their eastern front on May 2nd, 1915, at Bolinow comes next in historical importance after Flanders. Here three weeks' wait was necessary, but when the right wind came, the buried cylinders did their deadly work on a front twelve miles long. Two Siberian regiments were entirely wiped out ; 9000 were poisoned and 6000 of them died. As in Flanders, however, the strategical advance gained was insignificant. This was caused by certain " misunderstandings " ; the troops did not follow up their success and a big opportunity was once more let slip. Later there were many gas-cloud attacks both on the western and eastern fronts ; that made by the Austro-Hungarian forces on the plateau of Doberdo on January 29th, 1916—where 5000 were killed by gas —was one of the biggest events in this category ; it was carried out by the 62nd battalion of Austro-Hungarian (K.U.K.) Sappers.

The same procedure was then, of course, adopted on the opposing side, but the Central European Powers soon relinquished this type of warfare. Gas attacks dependent on the wind did not achieve all that was expected of them ; they were too difficult and dangerous for the troops who carried them out. Even the larger and more successful ventures had not conquered much territory and moreover, great progress had been made meanwhile in the manufacture of gas shells.

As early as October, 1914, it was reported that gas shells had been used against the Germans, and that Germans suffering from gas-poisoning had been found

in the trenches. Much was heard of the French turpinite shell at that time, but it never became quite clear what it was loaded with. Possibly it contained carbon monoxide, although this particular poison was not otherwise used in the War. Production of gas shells on a large scale began for the first time in 1915. At first only irritating and incendiary gases were used; soon however, shells containing poison gas proper were distributed to the French troops, but then there was a long delay—mainly on account of the danger to the men employing them—before the events of the War induced the French Government to give permission for their use. These first poison gas shells were filled with phosgene or hydrocyanic acid.

At Verdun in February, 1916, the Germans became acquainted with phosgene shells for the first time. Phosgene is a compound of chlorine and carbon monoxide. It was first discovered in 1812 by the English chemist, Sir Humphry Davy, when he exposed chlorine and carbon monoxide to the sun. Before the War it was used in the dye industry; later, a chemist working for the Allies found that it was much more poisonous than chlorine, which had already attained a considerable reputation in gas warfare. Traces of phosgene in the air suffice to produce severe inflammation of the eyes and bronchial tubes, and even death. At the same time phosgene poisoning is exceedingly perfidious. The first symptom—a slight faintness—soon disappears; the patient seems restored to health. Then, often after a lapse of several days, a relapse and possibly death. A vigorous attack with 7½-centimetre field-gun phosgene shells produced catastrophe with lightning rapidity.

The Germans made very little use of phosgene. They preferred diphosgene, the gas with the green cross as they called it. Its scientific name is trichloro-methyl-chloroformate, a harmless fluid with a boiling-point very little above that of water. But when the " green cross " shells exploded and the contents were transformed into swirling clouds of gas, it revealed its poisonous nature to the full. This is slightly less than that of phosgene, but on the other hand remains much longer active in the air.

Chloropicrin is another derivative from chlorine. Its action is similar to that of phosgene and diphosgene ; it injures the mucous membranes, including those of the stomach and intestines, and causes diarrhœa, vomiting and colic. It was used by all the belligerents in the War, either alone or in conjunction with other poisonous substances, as a cloud-gas, for filling shells and for charging mines. Diphenyl-chloroarsine, a sensory irritant, known as Blue Cross in Germany and Nose Gas in England, is a compound of chlorine and is not a gas but a solid ; it was used by the Germans in conjunction with the " Green Cross " just described. " Blue Cross " is not poisonous, but is extraordinarily irritating ; it was able to penetrate gas masks, causing sneezing and coughing, which tormented the men till they were obliged to tear off their gas masks, leaving them exposed to the poisonous diphosgene (" Green Cross "). " Blue Cross " and " Green Cross "—their effects were known at the German front as " colour gaps."

In any case they were very successful as attacking media, while so-called " Yellow Cross "—" Blister Gas "—was an excellent means of defence and prim-

arily so used. In the year 1886 the chemist, Viktor Meyer, had already reported to the German Chemical Association on dichlorodiethyl sulphide, an oleaginous fluid, which induced severe inflammation of the skin in persons who worked with it; in many cases the symptoms are not perceptible till several hours or days after contact. The fluid possesses a faint odour reminiscent of mustard or garlic. The purer it is, the more nearly odourless.

"Yellow Cross" was first used as ammunition in the struggle for Ypres on the night of July 12th–13th, 1917. It proved decisive. The number of deaths caused by the mustard oil shells was probably inconsiderable, but so many men were disabled that the Allied front was progressively decimated. When the "Yellow Cross" shells exploded, the fluid was sprayed out for several yards in all directions. It adhered to everything, penetrated everything, including shoes and uniforms, and was carried by the latter into places till then uninfected. Thick clouds of mustard gas brought death; but the small sprays were even more effective, since they disabled such large numbers of soldiers. Wherever a drop of the liquid reached the body—even through shoes or clothing—the skin was corroded, painfully inflamed and covered with blisters. Incidentally, it was observed in this connection that Negroes are far less sensitive to this poison than Whites. After experiencing the effects of "Yellow Cross" the French manufactured a similar compound; this they named "Yperite" in painful memory of the place where it was first used.

The American Lewisite is similar to mustard oil. When the Americans entered the War, they adopted

gas warfare on a large scale. They had the best gas regiment, the first companies of which landed in Europe at the beginning of 1918. In Lewisite, a compound of chlorine and arsenic, they hoped they had found a medium of attack that would play an important part in the War. Eight hundred Americans voluntarily submitted to be locked up in a factory, cut off from any communication with the outside world, so as to devote themselves to the manufacture of poison gas. They called it the Dew of Death, because, dropped from aeroplanes, it was to be poured on the enemy like rain. The War was over, however, before it could be applied.

The list of the forms of invisible death which made their way into the trenches is by no means exhausted by the foregoing examples. It should be mentioned, for instance, that the French—the first occasion was at Vincennes—used bombs containing hydrocyanic acid, a poison whose action is well known. They were heavily censured on this account ; but this was unjust, for morally the use of hydrocyanic acid is not really any worse than that of other poisons ; and in any case the action of these bombs was no more effective than the others ; if anything it was less reliable.

Among the compounds of arsenic the American Adamsite deserves mention. It is named after its inventor, Dr. Adams, and its scientific name is diphenylchloroarsine ; it is easy to make and first made its appearance towards the end of the War. It acted as a very strong irritant and gas masks proved powerless against it. The American irritant gas, chloroacetophenone came too late to be used in the War ; it is alleged to produce the same symptoms as solar dermatitis. And there were many other poison gases, which

were tried out and then either replaced by more effective media or adopted ; all were directed to the same end : mass destruction, i.e. a contribution to the annihilation of mankind.

That was the chemical war—gas attacks and gas bombs ; so that the human brain was set the further great task of discovering ways and means of protecting the body from what the mind had invented.

The chief evidence provided by the prosecution in the action against the artist, George Gross, in December, 1930, was the drawing entitled " Christ with the Gas Mask." This portrait of the Son of God in His agony on the Cross, with a gas-mask over His face and wearing military boots, might well be considered liable to offend the sensibilities of believers who must be shocked at seeing the symbol of their faith depicted otherwise than as prescribed by the sacred nature of the subject. But the judges acquitted George Gross. They saw in the picture that which the artist had intended : the misery of a period and the idea that since the War, Jesus with the Gas Mask would die—for Mankind and as a symbol of that Mankind for whom in future the gas-mask was to be an indispensable adjunct of death.

Since April, 1915, when the greenish yellow chlorine cloud wiped out the French division at Bixschoote and men in their despair buried noses and mouths in the damp earth in an effort to escape death, since then the world has learned what gas-masks are. The new means of attack led to new methods of defence. The first respirators were simple bandages padded with gauze or cotton-wool, moistened and tied over nose and mouth. After the catastrophic results of the first

attack, Lord Kitchener issued an appeal to the women of France to make these respirators, and within a few days the whole front was furnished with them. At the same time someone devised the " bottle respirator," an extremely crude apparatus consisting of a plain bottle, of which part of the bottom had been removed, and which was filled with moist earth. When a gas attack was expected one put the neck of the bottle in one's mouth ; the air one then breathed had been cleansed of the poison gas by its passage through the moist earth.

These were the first attempts in this direction, very simple devices designed to give the soldiers some protection against gas. The efforts to find a satisfactory solution were continued with the greatest possible speed. The Germans were the first to produce gas-masks which afforded their troops anything approaching an adequate protection against gas and which were adapted to conditions on the battlefield ; and though the Allies worked for some time at their own designs, they ultimately copied the German models. Naturally improvements had to be made constantly. At the beginning of the War only a few poison gases were in use, but by the end the number had risen to hundreds, and the different ways in which they acted called for various methods of protection ; but the basic function of the gas-mask remained that of filtering the air.

Most gas-masks combined the protection of the respiratory organs with that of the eyes against irritant gases, and accordingly were fixed tightly on to the face ; the lines of the protected area varied in the different types used. The line of the German masks ran horizontally above the eyes across the forehead, extending beyond the lateral corner of each eye, then downwards

and slightly forwards, the side lines meeting beneath the chin. The English had gas-helmets at first, which enclosed the entire head and were padded at the neck. Later, as already mentioned, only the German type was seen on the French front. The eye-pieces were made of celluloid with a device enabling the wearer to wipe them clear ; the mask itself was made of cotton and later of impregnated sheepskin ; it was pressed close to the face by elastic bands.

The intake tube that filtered the gases was screwed into a metal ring fixed near the mouth. This constituted the most difficult problem in the manufacture of gas-masks. It was in the form of a small metal cylinder, fitted with a screwpiece, and containing a substance capable of absorbing the gases. Small grains of pumice-stone soaked in a solution of soda were first used, mainly as a protection against the so-called acid gases, chlorine in particular ; but when phosgene was used by the French and the English it became necessary to find some other substance. A layer of charcoal was then added, firs and pine trees providing an admirable raw material for its manufacture ; and in this manner the German forests saved the lives of countless soldiers. When leather masks were introduced and gas discipline was more firmly established, it became clear that the German forces certainly possessed the best protection. Hanslian reports that no such degree of perfection in this respect was achieved by any other country during the War.

The Allies having, as stated, adopted the German gas-mask model, turned their most studious attention to the contents of the filters. Experiments were made to find out what substances, while effective, would least

strain the wearers' strength ; for the interposing of a foreign substance through which air had to be drawn before it reached the lungs tended to exhaust the soldiers, particularly if great physical exertions were required of them. This is one of the most serious problems in the construction of gas-masks. One hears from Dr. J. E. Mills that the English brought out seven different types of masks during the War, and that in all fifty millions of them were issued. The corresponding figures for Germany are not known. Of Austria it can be stated that the troops were furnished with German gas-masks. The Russians manufactured their own gas-masks, since the English supplies did not suffice for their needs. Those of German manufacture, however, were most highly prized, and the Russian officers caused considerable competition among the men by offering large rewards for the capture of German gas-masks.

America, as we know, entered the War late ; but she made great efforts and spent vast sums to make up for the time lost. The American manufacture of gas-masks was peculiar in that it used coco-nut shells, which provided excellent charcoal for the filters. Coco-nut charcoal has a far greater capacity for absorbing and fixing gases than that obtained from oak or willow ; the only drawback was that there were not enough coco-nut shells to fulfil the requirements of the gas-mask industry. In an attempt to obtain sufficient raw material, appeals to patriotism were made. Coco-nut " days " were instituted, and the slogan " Eat More Coco-nuts " was proclaimed by placards and newspapers. But in spite of this the supply remained inadequate right to the end of the War.

When the vesicant bombs were introduced and it was found that mustard-gas penetrated all ordinary materials, including boots and equipment, clinging to them with the tenacity of an infecting bacillus, it became necessary to devise a protection for the whole body ; gas-proof suits were made, which though they protected from gas, proved extremely burdensome to the wearer and added one more torment to the long list. . . . Red Cross patrols and important points on the Front were provided with portable oxygen apparatus, which rendered the bearers independent of any form of gas attack. These were extremely serviceable as far as they went, but their weight made their general use impracticable. Gas protection had, of course, also to be found for the animals in the service of the armies —gas-masks for the horses and dogs and gas-proof cages for the carrier-pigeons.

Apart from the protection of individuals, efforts were made to combat gas attacks on a larger scale. It was attempted to dispel cloud-gas by means of bonfires, the intention being to raise the temperature of the gases and thus cause them to rise high enough to be harmless. The Russians attached great importance to smoke and soot, and made fires that gave out thick clouds of smoke, which they believed would absorb the poison gas. In point of fact it is improbable that this had much effect. However, braziers proved serviceable for degassing dug-outs, and all the trenches had them.

It is natural that the same chemists who made such efforts to evolve new poison gases should also have taken steps to discover methods of detecting its presence, and to invent devices for giving an early warning ; and indeed to this end much ingenuity was displayed. To

destroy the others, but protect oneself—that is the whole meaning of war.

On the 20th May, 1928, a catastrophe happened in Hamburg. Not many people were involved—only eleven were killed—but it aroused much comment. In the storeyard of a chemical factory a tank that had been used in the War and had contained phosgene became leaky. A few cubic centimetres of phosgene were liberated—the gas that had been extensively used on the Western Front and was later utilised in dye chemistry. For a few days this revived discussions of the poison gases used in the War, and it emerged at the same time that the French had ordered fifteen million gas-masks for the civil population.

Two years later there was an even greater catastrophe—the mysterious episode of the " poison mist " at Liége, through which 110 people were killed on 5th December, 1930. The cause was never revealed to the public ; but the generally held view that it was due to a quantity of liberated poison gas remained uncontradicted. Gas-masks and poison gas ! The whole world is now oppressed by the same thought. Wherever it is believed that a new war may come, preparations are made for chemical warfare. And though no country—with the exception of Russia—will admit it, no one doubts it.

It is highly probable that none of the Powers in question possess sufficiently large stocks of gas-masks or —still less—any considerable quantities of poison gas ; for this would merely be dangerous and certainly unpractical, on account of the continual technical progress in this field. It is more important that the national industries should be prepared to reorganise

themselves for the manufacture of poison gas and gas-masks. North America certainly spends a few million a year on preparation for chemical war ; it is to be presumed that France's preparations, to a higher degree than those of any other country, are devoted to the chemical side of the next war ; England has considerable sums earmarked for war chemistry ; Japan has invested large sums of money in an institute for the investigation of chemical war media.

Few details of these matters reach the public, and still less is known of the practical advances made by the individual research institutions in each country. These achievements are the most jealously guarded military secrets ; but it is considered probable that scientists and technologists experimenting on this subject have taken as their working bases mustard-gas —the German Yellow Cross—and gases belonging to the arsenic group starting from the American Lewisite.

These researches profit such peace industries as deal in poison gas and gas-masks. The gas school of the Auer Company in Oranienburg has rapidly gained considerable importance ; it gives instruction in the use of gas-masks to fire-brigades, mining engineers, chemists and anyone else who wishes for it. And in nearly all countries steps are being taken to provide the civil population with a means of protection against gas.

This has gained particular importance since it has been realised that by means of gas-bombs or the spraying of poisonous substances a few aeroplanes are capable of imperilling the entire population of even the largest city. It seems that in the Great War the towns behind the fighting-lines remained immune

from enemy attacks of this kind, since both sides were evidently reluctant to add this horror to the War : but there is no guarantee that this would be so in the next war. True, there is division of opinion on this point ; some hold protection of the civil population, particularly in big cities, to be the first necessity, others consider the fears of poison-laden, death-bearing aeroplanes to be greatly exaggerated and believe that there are great difficulties in the way of aerial gas attacks. Nevertheless the thought is in everyone's mind, even though all may not go so far as Romain Rolland, who uses the most terrifying imagery to depict the horrors of the aerial war of the future, and foretells that man will return to cave dwellings as the only escape from a death descending from the skies.

There is, of course, one more conceivable method of ensuring safety from gas for civil populations—and indeed armed forces as well—and that is by means of international agreement. This would certainly be the simplest way and there has been no lack of conferences to this end ; but we know their value : at the best a unanimous decision is reached and an agreement signed by all. . . . But is this sufficient reason for assuming that gas-masks may be dispensed with " next time " ?

Is the next war then to be mankind's Dance of Death—a dance of the green, yellow and blue crosses on Death's black banner ? Or will an adequate means of protection against gas be provided, as the optimists imagine ? This question is being discussed in every quarter, sometimes with exaggerated terror, and sometimes in the impartial spirit of scientific enquiry. Even in medical circles the subject comes up and conjectures

are made as to what service the medical profession and first-aid helpers will provide for the victims of gas poisoning.

The division of poison gases into vesicants, popularly termed " blister gas," sensory irritants or " nose gas," lung irritants or " choking gas " and lachrymators or " tear gas," has been found useful for purposes of classification (in Germany they are known as " Yellow Cross," " Blue Cross," " Green Cross " and " White Cross " respectively), as most of the known poison gases (some of them are not, strictly speaking, gases at all) belong to them. The few gases that do not, such as carbon monoxide and hydrogen cyanide, are unlikely to play any important part in gas attacks. Foremost of the asphyxiant (choking gas or " Green Cross ") group are phosgene and diphosgene. These gases are peculiarly noxious, not, however, very obtrusive, so that only the most experienced may recognise them by their taste and smell. They have a devastating effect on the lungs and attack the tiny tubules, the final subdivisions of the air passages which are themselves gas cells and normally only permeable by air. The gases injure the walls of these minute vesicles, so that blood is able to penetrate them and some of them become filled with a mixture of air and blood instead of air alone. Thus the lungs rapidly become heavier, their volume—normally appropriate to the needs of respiration—diminishes appreciably and what is known as pulmonary œdema sets in. The respiratory muscles struggle in vain to pump air through ; the heart strives in vain to force on the reduced circulation of the lungs—meant to provide the whole body with blood newly supplied with oxygen ;

but the end is in sight, the patient is about to suffocate and his heart about to fail.

It is no easy task to help a patient in this condition. If he has grasped the situation and is to co-operate to the full, he must remain as quiet as possible. Every movement of the body makes demands on the lungs and the heart, and any attempt to avoid the danger by running away from the infested territory only increases it. Retreat must be very slow and careful and even deep breathing must be avoided. For similar reasons it is a mistake to apply artificial respiration to such a patient, though he is gasping for breath ; it would only injure the lungs further. The doctor in attendance on these cases has them carried on a stretcher, even if they themselves desire to walk. Sometimes blood-letting helps, though it must be remembered that the blood is very viscous and will not pass through an ordinary canula. Quite a large quantity may be withdrawn—the removal of a quart of blood gives much relief to the heart. Cardiac drugs and saline injections are also used, but moderation in all these is required, since the patient needs rest. He may survive the first day, and then there is hope. . . .

Among the sensory irritants—" nose gas " or " Blue Cross "—are the compounds of arsenic, arsenic trichloride for example ; these compounds, such as Adamsite, are not gases at all in a physical sense, but are made up of finely divided particles, and they are not fluids either, but solids in powder form ; it is, however, simpler and more practical to include them under the heading of " war gases." They have a powerfully irritant action on the mucous membranes, in particular the conjunctiva of the eye. Next the respiratory organs

are attacked and there follow weeping, coughing, sneezing, copious secretion of mucous, headache and nausea ; the patient experiences depression and a sense of hopelessness.

The permanent injuries are not great as long as the gas-mask has not been removed and the way made open for other poison gases simultaneously released. There is only one form of treatment and that is fresh clean air. If the mucous membranes of the respiratory organs—the bronchi—have been severely damaged, inhalation of soothing oils, of menthol or eucalyptus, may be prescribed. As a rule, however, this is not necessary and the mucous membranes soon recover without such assistance.

With vesicants, so called " blister gas " or " Yellow Cross," the case is different. Dichlorodiethyl sulphide, Lewisite and the rest, though the effects only gradually emerge, cause the most terrible corrosion of the tissues. Sometimes an odour reminiscent of mustard or garlic gave warning to the troops, but more often the terrible mustard-gas was not recognised until its effects had set in, i.e. corrosion of the skin and mucous membranes followed by inflammation, suppuration and ulcers. The corrosion deprives the skin of its outer layers, leaving the way open for pyogenic cocci ; erysipelas and other infections find fruitful soil for development. The mucous membranes of the larynx and the trochea are similarly attacked, which gives rise to coughing and shortness of breath ; and speech becomes a toneless whisper. The mucous membrane is cast off in shreds and it is not uncommon for pneumonia to follow. The eyes are similarly injured. None of the internal organs escape ; kidneys, liver,

intestines and muscles are all affected and reac violently. The condition lasts for a long time and it is often weeks before death releases such patients. . . .

Those who touch the bodies or polluted clothing of the victims of this poison are attacked by the same torments. This naturally hinders the rendering of prompt aid. Doctors and nurses must wear rubber gloves and change their clothes with the utmost speed. Should only a few minutes have elapsed since coming into contact with the mustard-gas, it is worth trying to remove it with soap and water.

An excellent treatment—at least within the first quarter of an hour—is a solution of chloride of lime, which neutralises the poison. Other oxydising agents, such as hydrogen peroxide and potassium permanganate, are also useful, and so is washing soda ; all of these must, of course, be applied to the skin in aqueous solution. During the first half-hour dabbing the skin with petrol (or petroleum) is recommended. Later, however, when once ulcers have formed, treatment becomes very difficult. Powder is injurious, since it leads to the formation of a crust, beneath which suppuration proceeds. Ointments too, can only be applied later. So there is often nothing left but to lay these poor creatures on a water bed, as in cases of severe burning. A ward full of such patients is the most moving kind of anti-war propaganda possible.

CHAPTER IV

BENZENE AND PETROL

In 1932 there occurred a sensational lawsuit in Wiener-Neustadt, an industrial suburb of Vienna. The defendants were the proprietor, the works' manager and the foreman of a factory manufacturing rubber goods mainly for hygienic purposes. The charge concerned the death of five persons and severe injury to eighteen others, caused by benzene poisoning. The accidents had occurred in January, 1930, all under identical circumstances. Women working in rooms filled with benzene vapour fell sick, suffered from headaches and vomiting, were given a few drops of spirits of ether by the woman superintendent or went to the doctor for treatment. Five of them died and eighteen suffered prolonged illness. The case revealed negligence on the part of the factory inspectors, whose attention the proprietor had drawn to the frequent indispositions of the female workers; and it was probably for this reason that the defendants were acquitted.

Benzene poisoning is certainly not an everyday occurrence, but neither is it exceedingly rare. All textbooks on toxicology treat the subject. The similarity of the symptoms manifested by persons taken ill in a factory where it is used ought to have aroused attention, and the expert witnesses in the Wiener-Neustadt action were emphatic on this point. The symptoms begin with malaise, headache and vomiting —these are of course, not typical. But the vomiting

soon increases alarmingly. The women stated in court that they were finally obliged to vomit several times an hour. Characteristic of the cases that led to serious illness or death was the occurrence of slight hæmorrhages in the skin and gums, nose-bleeding, vomiting of blood and excessive pallor, symptoms strongly reminiscent of scurvy.

In severe cases the blood picture is very typical. Benzene has a particularly virulent action on the bone marrow, which plays an important part in the formation of blood ; and marrow contains a high proportion of fat, of which benzene is a particularly powerful solvent.

Benzene, as every student of chemistry knows, is one of the most interesting and important substances in organic chemistry. Its molecule is made up of six atoms of carbon and six of hydrogen, so arranged as to constitute the well-known benzene ring, which is the starting-point for many kinds of aromatic compounds. Benzene itself is a clear liquid with an ether-like smell, of low boiling point and readily inflammable. (The factory proprietor mentioned above had previously owned a rubber factory in Pressburg in which a benzene explosion has caused the death of eleven women workers.) Benzene is derived from coal tar and is a by-product of the gas industry. It is utilised in a large and varied number of industrial processes, in the dye trade, for vulcanising rubber and now, perhaps most of all, as automobile fuel.

In short, it is useful in many ways. But on the other hand it is extremely poisonous, and this has been known since it was first used. There have been cases of acute poisoning, both suicides and accidents. Someone once

drank two tablespoonfuls of benzene by mistake and died ; dizziness and defective pulse, followed by loss of consciousness were the symptoms. An interesting case was when seventeen persons were to receive an inoculation against typhoid and were accidentally injected with about a cubic centimetre of benzene each. It so happened that the results were not severe. As benzene is sometimes used in medicines, for example in some diseases of the blood, mistakes can occur here too and may have serious consequences. But all this is of relatively little importance in an account of benzene poisoning ; important are the occupational poisonings of which, unfortunately, a large number of cases are on record.

Glandular tumours as a consequence of acute benzene poisoning are rare ; but the reported cases in which portions of the lung have mortified and the dreaded symptoms of gangrene of the lung have set in are more credible. Where occupational poisoning is concerned, however, chronic cases are more usual—i.e. the cumulative effects of exposure to the poisonous vapours, as in the Wiener-Neustadt case. Insufficient ventilation is the cause of these and similar tragedies. Such cases constantly occur in factories where benzene is used, rubber works, glue factories and shoe factories, for example. Lewin describes a case of a worker whose task it was to distil 1000 to 1500 kilograms of benzene daily and clean the still every few days. He worked thus for four years and then suddenly " came over queer," suffered from cramps and paralyses and became delirious. Subsequently he recovered and returned to work, with the result, however, that the cramps and delirium returned.

In a bicycle-tyre factory, nine girls fell ill and four died. The slight hæmorrhages of the skin and mucous membranes—mentioned above—were observed in these cases. Workers handling black varnish-oil, a coal-tar product in which there is some benzene, have been similarly poisoned. From an American industry we have the fatal case—reported by Alice Hamilton—of a man who fell dead after entering a tank that had contained benzene.

The Parisian investigators, Flandin and Roberti, give an account of the autopsy on a woman employee who worked with rubber dissolved in benzene in a small, warm, ill-ventilated room in an automobile factory. Three other women fell ill at the same time, one of whom also died. Rochetti, an Italian, mentions death from benzene of two female workers in a factory manufacturing waterproof fabrics ; while Giulio Medea reports seven fatal cases of benzene poisoning that occurred in the Milan rubber industry in 1920–1921. Some paints contain benzene, a danger to those who use them.

The enduring effects of benzene poisoning are stressed in a report by Rohmer, Baldridge and Hausman. They describe the case of a man employed in a rubber factory, who gave up his work because he was feeling ill. Not till some weeks later did hæmorrhages set in, after which he developed all the typical symptoms of chronic benzene poisoning. Finally he became delirious, even blood transfusions proved unavailing and he died two and a half months after leaving work.

The destructive action of benzene on the blood is sometimes, as already stated, employed therapeutically.

It is used in cases of leucæmia, a condition characterised by the overproduction of white blood-corpuscles ; it is sometimes possible to benefit patients suffering from this dangerous disease by treatment with benzene.

Cases of occupational benzene poisoning then are by no means unknown to the persons concerned in regulating such matters. It has been learned that the risk of accidents such as occurred in Wiener-Neustadt may be averted by the provision—and proper use—of adequate ventilation. It has been established that as little as a hundredth per cent of benzene in the air of a room is enough to cause poisoning.

Accordingly, industrial hygiene experts have suggested that all workers employed in factories where benzene is used should be submitted to a medical examination, say once a month. Benzene poisoning is first revealed in the blood-picture ; a reduction of the number of white corpuscles by 25 per cent is an indication of benzene poisoning and shows that attention is needed. It was further recommended that the air in the workrooms should be analysed for its benzene content. The Viennese engineer, Dr. Hans Löffler, describes an apparatus for carrying this out, in which the action of ethyl alcohol on benzene is used as an indicator. It is important to draw attention to these facts, since the uses of benzene are constantly increasing and cases like that in Wiener-Neustadt must be prevented in future.

Benzene and petrol, though by no means identical, resemble each other inasmuch as they are both compounds of carbon and hydrogen, and are used for similar purposes ; in filling stations, for instance, they are stored side by side—not always peacefully !

Here petrol is treated with care, not only on account of its highly explosive properties when mixed with air, but also because inhalation of its vapour may easily cause illness. The symptoms of petrol poisoning do not differ widely from those of several other kinds of poisoning; headaches, nausea, pallor, lassitude and fainting: these are not particularly typical, but locality and accompanying circumstances usually indicate the source of the poisoning. Death from inhaling petrol fumes often used to occur in garages and also in workshops, factories and so forth in which petrol is used in large quantities; in laundries, for example, and patent leather factories, also in factories in which bones are the raw materials employed. Here the petrol is needed for removing the fat. Dissection of the bodies of those who have died from petrol poisoning often shows hæmorrhage in the lung and also in the kidney; but in some cases no indication of the cause of death can be found.

Sometimes fatalities have been caused by the swallowing of small quantities of petrol. It does not need much (particularly with children) to cause severe poisoning—a single spoonful is often enough. Death is often preceded by delirium and a loss of consciousness which resembles intoxication.

It is known that there are people who intentionally inhale petrol fumes, hoping to derive pleasure from the ensuing intoxication and to escape into a world of phantasy and hallucination. This vice is not, however, very common. The inflammation of the optic nerve caused by prolonged absorption of petrol strongly resembles that sometimes found as a result of severe nicotine poisoning.

CHAPTER V

TOBACCO

The 16th November, 1930, was celebrated in Paris with the sentiment and charm that the French know so well how to produce on these occasions. It was the 400th anniversary of the birth of Jean Nicot, whose name will always be linked with the history of tobacco and of smoking by the designation of the active principle of tobacco as " nicotine." Tales were told of him at his anniversary celebrations—in fact, speeches to his memory were their principal component—and, obedient to the dictates of fashion and their own friendly impulses, the participants further elected a Beauty Queen from among a large number of competing female cigarette smokers.

It was a delightful and appropriate festival, though on the other hand it must be admitted that long before Nicot, tobacco had been known in Europe—had been treasured, loved and abominated, even as it is to this day. But it was Nicot who popularised it and did battle for it—even though his opponents did not realise that there had been a battle at all !

If we go as far back in the history of tobacco as we can, we find indications that the smoking of dried twigs and leaves must have been practised in remote prehistoric times, and we can reasonably suspect that wherever tobacco grew in its conspicuous expansiveness, it must have been this plant which was smoked. We can always rely on the instinct of primitive people when it is a case of finding something to excite and bemuse the senses.

On a relief executed by the Mayas, long before the Christian era, in what is now Mexico, a priest is depicted holding a kind of pipe with smoke pouring out of it. Smoking very likely began by being a sacred act and a privilege of priesthood ; but it was probably not long before this privilege became a general practice —dry intoxication being just as attractive as the other kind ! In any case Montezuma used to smoke, irrespective of any religious cult, at the time when the Spanish conquerors laid waste his country.

Among the presents made to Columbus and his followers by the American Indians when, in 1492, they landed at the Island they called San Salvador, were dried leaves, which the Spaniards lightly threw away. As they had sailed the seas in search of gold and not dried leaves, this is understandable. These, however, were tobacco leaves, and it did not take long to discover their use. Oviedo, who spent a long time in the New World, mentions in his history of the West Indies, published in 1526, that : "Among other vices, the Indians practised a peculiarly harmful one that consisted in inhaling a kind of smoke (which they named tobacco) in order to stupefy themselves."

Corti tells us that according to the Bishop de las Casas (writing about this time) : "The plant whose smoke is breathed by the Indians is plugged into a dried leaf, forming a kind of torch. The Indians light one end and suck the other, thus drawing the smoke into their bodies when they breathe, bemusing themselves and producing a sort of intoxication. They assert that when they do this, they become impervious to fatigue. These Tobaccoes, as they themselves call them, are now also used by the settlers. I have seen

many Spaniards using these things, who, when reproached with this vile habit, replied that it was now impossible for them to lay it aside. I cannot conceive what flavour or advantage they can find in it."

Europeans also observed the practice of smoking among the natives of other parts of the Western World, in Brazil and also in North America, where the tobacco pipe played an important part.

In common with the Bishop de las Casas, most other Europeans did not perceive the " flavour and advantage " of tobacco. A few sailors only, who had picked the habit up in the West, laid in a store of tobacco so as to be able to smoke at home. There they enjoyed an enormous sensation, though sometimes, like Rodrigo de Jerez, the first smokers were martyred for their cause and had to pay for their ungodly practices with Inquisition and the dungeon ; for it seemed ungodly to the people of that time that men should go about with nostrils smoking " like chimneys " ; and it was not until the number of smokers had grown considerably that persecution ceased—at least for a time—and the opinion that they were possessed of the Devil declined.

Francisco Hernandes de Toledo, Physician-in-Ordinary to Philip II, is worthy of mention. His Imperial master had sent him to Mexico to study the animals and plants. Among the interesting specimens he brought back were some tobacco seeds. The plant had caught his attention by reason of its beautiful flowers, and it soon became fashionable to grow them in one's garden and point with pride to this new flower from the West Indies.

But from being the whim of a few sailors and the

fashionable hobby of a few wealthy dilettanti to making a world-conquest, tobacco had a long way to travel, and Nicot was the pioneer.

In 1559, Jean Nicot of Nîmes was the French Ambassador at the Lisbon Court. He had understood the art of making a career for himself and was greatly respected. He had been sent to Portugal to arrange a marriage between the two Courts (which, by the way, came to nothing), and was then instructed to look about him and see what these Portuguese, who were well known as seamen, had brought back of interest from distant lands. Among them he certainly found some rare and useful things : indigo, a wonderful dye, which he was able to send to his king ; and then again, he had heard of the tobacco plant and its medicinal properties. At that time the ulcers known as noli me tangere (possibly cancer or tuberculosis of the skin), were greatly dreaded. Someone had found that tobacco leaves proved efficacious and Nicot tested it on one of his servant's friends. The treatment proved most successful and he was able to report the discovery of a new remedy for ulcers and abscesses that had hitherto remained incurable. By this means he drew upon himself the attention of prominent personalities at the Paris Court.

Nicotine was not discovered until many years after the recommendation of the tobacco plant by Jean Nicot ; but tobacco soon became famous for its therapeutic properties, and within a short space of time was being dispensed as a cure for almost every complaint—perhaps comparable to radium in our own times, which was hailed by many as a universal panacea at the time of its discovery. Thus it is not surprising

that Nicot gained fame, and that in the treatise on Agriculture published by the brothers Liebault in 1570, the tobacco plant is named Nicotiana. It retained this name and when the active principle of tobacco, an alkaloid, was discovered three hundred years later, it was called Nicotine, and Jean Nicot joined the immortals.

Two factors, then, were responsible for the wide reputation enjoyed by tobacco; on the one hand, smoking, practised with avid enjoyment by many Spanish and Portuguese seamen, and on the other hand, the belief that the plant possessed almost magical healing properties. The latter, however, did not survive long; no medicinal use is now made of nicotine and tobacco.

An important step in the advance of tobacco smoking was made by the English, who had long been jealous of the Portuguese and Spaniards and were determined to outstrip them. English sailors soon possessed themselves of tobacco and it became evident that the English could smoke too.

Sir Walter Raleigh, who discovered Virginia, became a keen smoker and did much to further the practice. It was fairly new in England, however, and the number of smokers was still small. Thus the story of the "presence of mind" shown by Sir Walter Raleigh's gardener is perfectly credible. Coming upon his master smoking, he thought he was on fire and threw a bucket of water in his face.

The practice of smoking then spread with amazing rapidity in England, and Corti rightly observed that the cultivation of the potato, which was brought to Europe at about the same time, developed much more slowly.

At the same time tobacco was by no means cheap ; on the contrary, it was very dear—worth its weight in silver, though not in gold. It was the fashion to smoke and as the supply was still small, tobacco fetched a high price. Naturally there were many opponents and James I, one of the most prominent, set himself to put an end to this " disgusting practice." To this end he published his " Counterblast Against Tobacco " which was certainly widely read. He used very strong expressions and spoke of the " pollution of the Christian earth by infection with this frightful pestilence," while holding up to ridicule all those doctors and invalids who believed in the healing properties of the tobacco leaf.

This polemical document, emanating from the King himself, caused a great sensation, but its effect was entirely negligible. Indeed, when in 1614 London was stricken with the Plague, tobacco was believed to be the sole means of protection, and in their terror the last remaining non-smokers were converted. London was conquered and neither the few last opponents, among them the poet Joshua Sylvester, who named tobacco " England's only shame," nor King James' proclamation of September, 1619, declaring tobacco a monopoly of the Crown, could alter that fact. In the end it occurred to the Government that it was better and more lucrative to tolerate tobacco and tax it. Thus, from being a cause for which battles were waged, tobacco was transformed into a source of revenue. Its future was assured.

The oldest German book in which mention of tobacco is made is Petri Andreæ Matthioli's *Herbal* published at Frankfort-on-the-Main in 1586. In this it is described roughly as follows : " This exotic growth

which first reached this country a few years ago, has now become a common garden plant. There are two species ; one with the larger, thicker leaves and the other with smaller, pointed ones. Here the plant grows half as tall again as a man in the first year and will often survive several winters. The seeds are usually contained in a pod ; in this country they ripen in August and September, fall out of the pod and sow themselves, and it is to be marvelled at that such a tiny seed can remain on the ground alive the cold winter through. The roots are large and woody, with many secondary roots, whitish or yellowish in colour, bitter to the taste, wherefore certain men believe it to be not unlike rhubarb in effect. For this reason Dodonæus holds it to be a variety of henbane. Be that as it may, in any case this herb possesses many wonderful properties."

These " wonderful properties " are also described in a book by Nikolaus Höninger of Königshofen-on-Tauber, which appeared in German at about the same time. In his book, *The World and Indian Kingdom of the Setting Sun*, he tells of the curious practices of the Indians of the New World who take a piece of rye-straw and fold it round a leaf of the herb into the shape of a pipe or round tube, then hold one end over the fire, " the other end they stick between their jaws so that the smoke and steam passes into their throat." Nikolaus Höninger then describes at length the uses of smoking and fumigation in the treatment of the sick.

From England the custom of smoking spread throughout Europe, encouraged on the Continent too by an epidemic of the Plague. Then came the Thirty Years War and the consequent migration of peoples,

which greatly helped in propagating the use of tobacco ; it was a considerable alleviation of the soldier's lot. Naturally there were again opponents of all kinds. Tobacco smoking, according to a contemporary document, was a punishment inflicted on the Spaniards by the Devil for the atrocities they had practised on the Indians. It was Father Jakob Balde who, in a satire, coined the expression " dry intoxication."

Prohibitions and severe penalties were imposed in many parts of Europe. But there were wars in progress at the same time, and it was impossible to be too severe with soldiers who smoked. And then again, money was needed for the War, and in this way the stage was reached at which England had arrived some time before : the recognition of the financial potentialities of tobacco for the State. Once the cigarette was invented the conquest of the world by tobacco was complete, and even the Americans, abstemious as they are, do not dream of prohibiting the *Herba Nicotiana.*

The first opponents of the fashionable passion for smoking, which increased with incredible rapidity, had the weight of medical opinion behind their arguments, and James I was quick to seize upon this in his famous " Counterblast " (1603). According to the royal treatise, smokers might anticipate tremors of the belly, apathy of the brain and sleeping sickness. When James visited the University of Oxford shortly after the appearance of this pamphlet, the event was celebrated by a scientific discussion on the question of " Tobacco and Health," at which the King and his court physicians were able to expound their views.

Among the many evils attributed to tobacco at that time and also later, one of the most surprising was

that smoking covered the brain with a black deposit in the same manner that a fire deposits soot in the chimney. To the layman this seemed fairly plausible, and there were even doctors who maintained that in dissecting the bodies of heavy smokers they had found this black patina. There were, in fact, no limits to the productions of imagination. Since then hundreds of years have passed, the world has long been conquered by tobacco, and the number of its opponents has become very small, but there are still some, and among them doctors, who, like the famous surgeon Billroth, hold smoking to be a vice injurious to health.

To establish the injurious effects of tobacco is much less easy than to point out its advantages. Every smoker, from Columbus' sailors, who brought the curious plant home with them, to the cigarette-smoking girl of to-day, knows the pleasant effects of smoking, the sensation of relief obtained after a period of abstinence when the first cigarette is lighted or the fragrance of a cigar breathed. " Tobacco, thou noble weed," wrote Lord Byron, and many other poets could be quoted.

Why do people smoke ? Physiologists find it hard to answer this question, and it suffices for the rest of us that we smoke because we like it, and that enjoyment is something scarcely possible to define. General Pershing, who was in command of the American army in France during the War, was surely right when he cabled to Washington : " Tobacco is just as important as the food rations. We need a thousand tons at once."

Habit-drugs, to which tobacco properly belongs, may be divided into two main groups, stimulants and narcotics or stupefying drugs. Tobacco has an excep-

tional intermediate position between the two ; and it is possibly this combination of exciting and soothing properties that give it its importance. One turns to tobacco to lend freshness and impetus to one's thoughts, and then again one takes it to steady the excited nerves and as it were damp their vibrations by enveloping them in smoke. " You are wrong," said Bismarck to Jules Favre in 1871, when he was negotiating the Peace Treaty with him and learned that the French statesman did not smoke. " Morally the cigar calms us, without in any way diminishing our intellectual faculties."

But the pleasures of smoking need no advertisement. Where the harmful effects of tobacco are concerned it is hard to make definite statements, for if one approaches the subject in an objective spirit one finds much conflicting evidence. Tobacco, like many other pleasure-giving drugs, is certainly a poison, but one to which the body swiftly grows accustomed and which it usually manages to overcome. The defence mechanisms of the human body are among the most obscure phenomena known to science and the study of the subject is still in its infancy. Perhaps it will be explained at some future time how the body defies—successfully and with pleasure—the oft-repeated daily attacks of the poison and further how it comes that, unlike morphia or cocaine, nicotine requires no increase in the dose to achieve its effect. The first puff at cigarette or cigar is always the best and there are those who for decades have found the same daily ration of tobacco enough and continue to smoke into old age without ill-effects.

There are, of course, and always have been people who are exceptionally heavy smokers. A man called

Stark of Berlin is reported to have smoked twenty-five cigars daily for sixty years ; and it is well known that some people smoke well over fifty cigarettes a day, apparently without any ill effects.

On the other hand there are those who have to pay for their indulgence, and sometimes where the warnings given by the body have not been enough the doctor is obliged to step in with prohibitions, turning a heavy smoker into a more or less obedient non-smoker. In this field one encounters widely varying degrees of tolerance and sometimes meets with a high degree of sensitivity which is not surprising when considered in connection with the general problem of sensitivity.

Only the most extreme cases of super-sensitivity come to the notice of the layman, who is astonished at the appearance of a rash, of blisters on someone who has been eating a few strawberries or a sardine. But apart from these obvious manifestations there are also others of an almost mystical obscurity ; in a highly sensitive organism there occur relationships between cause and effect that only the best instructed physician suspects, and damage caused by smoking is unquestionably among them.

It is also conjectural in how far certain disorders clearly caused by smoking are nervous or organic in nature. In any case the difference is not great, for it is by means of the nerves that the organism protests against any affronts it receives.

Attempts have been made to solve these problems by experimental means. This has been facilitated by the discovery of the essential principle of tobacco, nicotine, which can be extracted from the leaves by a fairly simple chemical process. It is a colourless, highly

poisonous liquid, and belongs, like morphia and other drugs, to the group of compounds known as alkaloids.

Some cigars contain 8 per cent, and others, such as the finest Havanas, only 2 per cent of this substance, of which the smallest quantity suffices to cause death within a few minutes. Its action is many times stronger than that of coniine, the alkaloid contained in hemlock, world-famous through the death of Socrates.

In animal experiments nicotine has much the same action as hydrocyanic acid. A quarter of a drop is enough to cause death in the case of smaller animals ; one or two drops is the fatal dose for the larger animals and probably for human beings.

In the study of crime, however, nicotine is of no significance. Its characteristic smell and sharp taste are too strong a warning. Only one instance of murder by nicotine is known in the history of forensic medicine ; this is the case of Count Bocarmé, who in 1850, murdered his brother-in-law, Gustave Fougnies, by means of nicotine.

More common are deaths resulting from practical jokes and wagers. In many textbooks of medicine the story is repeated of a man who within twelve hours smoked forty cigarettes and fourteen cigars without eating. He did not survive the fifteenth cigar. It used to be a frequent joke at students' drinking parties to put tobacco, cigar-ends or snuff into beer and then drink it. This probably led to serious consequences in some cases. The story of the death of the poet Santeul (during the reign of Louis XIV) is well-known. At a festival banquet the Duke of Condé threw snuff into his wine ; the poet finished the glass, felt ill the next moment and died in torment the following day.

Suicides have also been committed by drinking infusions of tobacco, though accidents from this cause are more frequent ; for after Jean Nicot's herb had been abandoned as a universal cure, it still retained a certain, though inconsiderable, position in popular therapy. Here and there decoctions of tobacco are to be found as a household remedy, for internal or external application—against worms, eczema or vermin—a multitude of uses can always be found for an ineffective drug. But these instances are insignificant in comparison with the " normal " cause of nicotine poisoning, i.e. excessive smoking ; as has already been stated, the tolerance shown varies greatly in individual cases.

The consequences and even the symptoms of nicotine poisoning also vary. Tremors, cold sweats, feeble heart-beats almost to the point of collapse, with weak pulse, are the most common indications. Military doctors asked for certificates usually recognised at a glance that the extremely pale young applicant with the weak, racing pulse, had brought about his condition by a night of over-smoking. Intestinal and stomach cramps can also occur. A soldier who while out of his mind swallowed thirty grams of chopped tobacco suffered, to begin with, loss of consciousness and muscular power, vomited and had contracted pupils (as with morphia) ; these symptoms were followed by cramps, which persisted for several hours until death ensued.

Nicotine poisoning very frequently affects the eyes ; a heavy smoker may quite suddenly experience an impairment of vision and be compelled to give up smoking completely for a number of weeks before the condition

can be alleviated. This tobacco blindness, the sudden appearance of a rapidly growing dark patch in the field of vision (similar to alcoholic blindness) has repeatedly been the subject of particular research. It is possible that these cases became more frequent in the years immediately following the Great War, on account of the home-grown, badly cured tobacco or tobacco-substitutes employed. These often have a lower combustion temperature than properly prepared tobacco, so that less nicotine is destroyed.

The most difficult question is the possible connexion between nicotine and arterio-sclerosis. Doctors vary widely in their opinions on this point ; those who smoke tend to be lenient in their views, whereas those who do not are very severe, and experiment yields no decisive results. This is probably one of the cases where the observation is appropriate that men are only equal before the law, but that Nature prefers to make differences. Each case must be judged on its merits.

Then again there are differences in the manner of smoking ; some people—mainly women—merely let the cigarette burn away, while others draw the smoke down into their lungs with a force which would do credit to an exhaust pipe ; some puff away in frantic haste and others smoke reflectively and with pauses. These differences naturally produce very varied physiological conditions. In addition, the different sorts of tobacco used vary in their effect. It is clear that cigarette smoking is particularly prone to lead to abuses such as inhalation, too hasty smoking and chain smoking, and therefore to ill effects ; but it must not be supposed that cigar smokers escape them. Toxicologists, while admitting the right to the normal enjoy-

ment of tobacco, are unanimous in declaring that cigarette smokers should be especially careful.

The woman smoker deserves a word of mention. She is a product of modern times ; thirty years ago a woman who smoked caused a sensation. Customarily women only smoke cigarettes ; it is unusual for them to take to a pipe or cigars, though the native women of Manilla have never smoked anything but cigars. In primitive societies smoking is by no means rare among women ; in South America, among the Samoyeds, in Africa, Asia and Russia nearly all peasant women have smoked papyrus-reeds for many years past.

Some choose to regard smoking among women as a symptom of a " return to Nature," and some as a sign of degeneration. Professor Lewin strongly opposes cigarette smoking in young women. " As vestals of the home women have very different fires to tend. And after all a woman's mouth is made for better things than to smoke like a chimney and reek of tobacco juice " ; as if smoking and kissing were incompatible, and as if women, if they chose, could not similarly object to men's cigars. However, they do not choose. The Viennese gynæcologist, R. Hofstätter, is another opponent of women smokers, he has devoted an extensive monograph to the subject and tries to establish that the cigarette demoralises young women, prepares the way for all evil, encourages idleness, and is a substitute for the healthy impulses of true love.

It is probable that women are less tolerant of tobacco than men and their greater sensibility can make them into correspondingly more unrestrained tobacco addicts, with a daily consumption far greater than that of most men. Moreover women are likely

to suffer more when cut off tobacco. Dr. Herman Beer of Vienna describes the case of a woman, who on giving up smoking manifested distinct deprivation phenomena. Men, on the other hand, get over the first days without smoking with no worse consequences than a little ill-temper. It is well known, however, that in most cases they begin to smoke again after the first few days—feeling like Franz von Liszt when he wrote : " I smoke the whole day and fear I should be wiser to give it up. But what would life be, if one were to live rationally."

Finally, in an endeavour to compromise between the pleasures of smoking and its undesirable consequences, attempts have been made to eliminate the nicotine from tobacco. These gave rise to the denicotinising processes, each of which is claimed to be the best, and which certainly have some effect.

More interesting are the attempts to strike at the root of the evil—in fact, the root of the tobacco plant —and to cultivate a kind of tobacco poor in or free from nicotine from the outset. The tobacco research institute in Karlsruhe has made notable progress in this direction and has managed after many years to produce a tobacco plant containing practically no nicotine and others with a very low content, round about 2 per cent. Thus those whose particular susceptibility has forced them to become non-smokers need not give up all hope. They may once more light a cigarette or cigar ; but it remains to be seen if they will be entirely unharmed. This is unlikely, for they obviously belong to the class of those who have to pay for their enjoyment ; this may seem unjust, but—who knows ?—it may be for the best.

CHAPTER VI

ALCOHOL

Alcohol, whatever one's feelings on the subject may be, enjoys the distinction of being the oldest poison cultivated by Man.

We may be sure that long before Noah suffered the humiliation of being found drunk by his sons, alcohol and intoxication had existed. The history of alcohol is a chapter in the history of culture—not so important as those dealing with food or clothing, but important nevertheless, and certainly not uninteresting. It is useless to try and trace the discoverer of alcohol. Like many other great men he must remain unknown. It may almost be said that the whole of humanity discovered alcohol, for in every part of the world and even under the most primitive conditions, Man has managed to find some natural product that could be used in the preparation of intoxicating drink.

It would seem, therefore, superfluous to collect all the evidence brought forward by some to show that beer is older than wine, by others that wine came first. It is clear that in countries where the vine flourished naturally, wine developed before beer, whereas in the many others in which the primitive farmers cultivated practically nothing but millet and barley these substances provided the local intoxicating beverages. Later, with the development of knowledge and craftsmanship, Man learnt to distil spirits, a third class of intoxicating liquor.

The chemistry of alcohol has been known for a long

time. Alcohol, sometimes known as spirits of wine, is chemically ethyl-alcohol. It is usually formed by the fermentation of sugars, which the action of yeast causes to split up into alcohol and carbon dioxide. The chemical formulæ involved are known and the beginning and end of the chemical process have been mastered by science, but the intermediate stages are still Nature's secret. The actual process of fermentation is still unexplained—i.e. the mystical part played by yeast, which has the hidden power of turning grapes into wine and potatoes into spirit, or at least of preparing this transformation. Chemists may think they have mastered it all, when they pin down the chemical formulæ in equations, but the biologist untrained in chemistry—the observer—is conscious that there is much which remains a deep mystery.

The fact is nevertheless undeniable that grape-juice is transformed into wine by fermentation ; for thousands of years men enjoyed the results, knowing nothing of the process by which they were produced and of course unaware of yeast. The yeast fungus was distributed by the wind and, acting on the grape-juice, turned it into the first must, which developed into the first wine. The days of organic chemistry and of wine-bottles stored in cellars were still a long way off. But wine was there—and the lovers of wine, and the poets who sang of wine, and the intoxication which followed its enjoyment.

The history and literature of the ancient world contain many references to wine. Sealed wine jugs are found in the tombs of Egyptian kings. In Homer's day the vine was indigenous to Greece, and there were many famous wine districts—countless colonies of

wine's original home, which investigators seek south of the Sea of Caspian.

Similarly beer has existed for countless ages, and may possibly have preceded wine. Its production involves an entirely different chemical process, i.e. the transformation of starch-containing plants. Beer has been known at least eight thousand years. Hieroglyphs on the world-famous "Blue Monument" in the Louvre—the oldest known monument of human culture, dating from about 6000 B.C.—mention beer as a drink offering. Moreover there are cuneiform inscriptions on Babylonian tiles dating from about 4000 B.C., which mention that labourers and officials were to receive a certain number of litres of beer daily as part of their wages. Further, an entire brewery showing every stage in the production of beer, has been found depicted on the walls of an Egyptian royal tomb. These do not necessarily show the beginnings of brewing, but are merely the oldest records.

This ancient beer was not the same beverage we know to-day. By analogy with the kvass still brewed in Russia, it seems probable that in many districts bread, and elsewhere other vegetable products, were used as the raw material in the breweries which formed part of the household. It appears that millet was the first plant to be used for the preparation of beer in those days in which the plough was still unknown. We can only form our conclusions by drawing parallels from conditions still obtaining among primitive peoples, the residue of those races to whom the Europeans have not yet introduced whisky and other spirits.

All investigators of these conditions describe the festivals in which they were allowed to participate—

religious festivals with mystic rites—as always accompanied by intoxication.

In the whole of Africa and Western Asia millet takes the place of our barley. In South America maize is used to some extent for the preparation of this type of alcoholic beverage, and in Eastern Asia rice. The underlying principle is the transformation of the starch into dextrose or maltrose, one of the substances that is susceptible of alcoholic fermentation.

The powers of observation and inventive faculty of primitive peoples are most remarkable. Among the Amazon tribes, for example, the women chew the cassava, which is rich in starch, almost as if they knew that saliva contains a ferment that transforms starch into sugar which is capable of being alcoholically fermented. These beverages, Giamanchi and Masata, as some are called, contain a very small percentage of alcohol, but at feasts they are drunk in such huge quantities that they produce a considerably delirient effect.

Soma, the mysterious drink of the Hindus and Persians, was a (probably very weak) form of beer. Whether this drink, which is often mentioned in the Vedas—the sacred Indian writings—as beloved of gods and men, was derived from barley, millet or some entirely different plant, is not known. Professor Paul Lindner suggests that this was not a case of direct action by yeast, but that the first stage was brought about by "T.M." germs, which have lately been found useful in the treatment of intestinal disorders.

The beer we know, which has a fairly high intoxicant action, is made from barley malt (and sometimes wheat malt), water, hops and yeast.

Brewing has now become an independent science and requires a knowledge of technology, chemistry, pathology, statistics, history and nutrition. Gambrinus, its " patron," is said to have been a king of Flanders at the time of Charles the Great. In any case it is a science that is interesting in all its branches and of particular importance in national economy.

The medical profession recognises that beer has highly nutritious properties ; but this is somewhat stultified by its high price and the alcohol it contains. The alcoholic content is usually 3 to 5 per cent—" non-alcoholic " beers contain less than 1 per cent. Beer is drunk much less than it was formerly, although it has certainly not deteriorated. This has been caused by poverty among the people and sport among the young.

We have already noted that wine was known at the time of the Old Testament. Wine, like beer, has its own history ; many people take seriously the philosophy of wine and do not find it surprising that wine was regarded by the ancient Greeks as a gift of the gods—the gift of Dionysus for the pleasure of the immortals and men. Many religious ceremonies include the use of wine. It was known to the Chinese over four thousand years ago—but only as an offering for the gods, of which no mortal might partake. But the vine and its pleasures were made known to the rest of the world by Greek sailors, and when Cæsar conquered Gaul his soldiers were able to enjoy the excellent vintages for which France is still famous.

Champagne is the favourite child, the Benjamin among wines. It is said to have been discovered towards the end of the seventeenth century by Don Pérignon, the cellarman at the Abbey of Haut Villiers.

Wine, when made from grapes, is certainly the noblest of alcoholic beverages. It can, however, be produced from a number of other sugar-containing plants. The best known of these products is palm wine, which has existed since time immemorial and is still the local intoxicant wherever the palm grows. An incision in the trunk allows the sweet sap to run out, and from this to the preparation of wine is but a step—it is an easily acquired accomplishment. Palm wine orgies are known wherever the palm grows, in Africa, Asia, South America, and in the South Sea Islands—explorers have often described them. Other plants yield sweet juices that may be used for the same purpose. Bananas, cacti, agaves, sugar-cane and many kinds of berries may be pressed into the service of alcoholic manufacture. Milk sugar too—notably that in mare's milk—can be transformed into alcohol by fermentation. Kattych, drunk by the Tartars of the Steppes and the Kirgis, contains 3 per cent alcohol.

Wine proper, however, contains much more alcohol, 9 to 10 per cent on an average ; and there are stronger wines containing up to 25 per cent, which is a very potent proportion. Champagne contains about 13 to 14 per cent.

Wine consumption varies widely. In France it is a hundred litres per head of the population, in Sweden not quite one. This depends upon production, price and custom. The primary factor is of course the soil, which causes the grape to flourish in one district and not in another. Much might be said about wine, as everybody knows. It is a wide field. . . .

The distillates, or spirits, form the third group of

alcoholic beverages. Here again, no single inventor is known ; there were probably a great many in different places. Conceivably when wines and beer had palled, inventive minds, independently of one another, discovered that by distilling alcoholic liquids something new, i.e. spirits, could be produced.

The science of distilling spirits from wine was known to Marcus Græcus, an alchemist of the eighth century, but at that time spirits were a precious commodity, part of the apothecaries' stock-in-trade. Later it was discovered that this aqua vitæ could be prepared from grain and its enjoyment was no longer restricted to invalids.

In Bavaria there was a tax on spirits as early as the middle of the sixteenth century, an adequate proof that it was consumed in some quantity. About a hundred and twenty years later spirit was being produced from potatoes, which placed its manufacture on a broad basis. The next step was the development of spirit distilleries—an industry of great importance, particularly in relation to agriculture.

The manufacture of spirits is very simple in principle. The raw materials are substances containing sugar, such as sweet turnips, maize stalks, fruits, honey and so forth or, alternatively, substances such as grain, potatoes, maize, and others which contain no sugar, but starch ; the starch is transformed into sugar by means of malt. The addition of yeast to the sugar-containing substances produces an alcoholic liquid by fermentation ; this liquid is then " distilled "—i.e. vaporised and recondensed by cooling, thus completing the process. Modern methods of manufacture are, of course, more complicated than the bare outline given

here and include special devices for producing a spirit of high alcoholic strength.

Simple methods—even the very simplest—are, however, also effective, as is shown in primitive communities where modern technical progress has not penetrated. During the War when prohibition was imposed in Russia, and even the bootleg trade was no longer able to provide the popular vodka, every large farm-house had a small still for producing samagonka, a by no means unpalatable substitute for vodka. One can imagine that the technique was fairly crude. But distillation is also known to far more primitive peoples ; the Burjats of Southern Siberia, the Tartars from the district between Turkestan and the Altai mountains, the natives of the South Sea Islands, the peoples of Eastern Asia, Hottentots and American Indians—all have long had their own spiritous liquors. These were, however, never of such concentrated strength as the European " firewater " to which they were later introduced by the Europeans and American whites—an introduction which had catastrophic effects comparable to those of the most devastating weapons of war.

Spirits have on an average an alcoholic content of between 40 and 50 per cent. Brandy and rum contain somewhat more. Liqueurs, on the other hand, are usually much weaker, and there are " ladies' " liqueurs containing mainly sugar. But even these are agreeable to drink and can easily produce lightheadedness. And that, one must suppose, is their purpose.

An old prayer runs : " Glory be to Thee, God the Eternal, Lord of the World, Thou Who hast created the fruit of the Vine." And Socrates : " To me, Oh friends, it appears right that man should drink ; for

as oil is to the flame, so wine refreshes the soul, mitigates sorrow and inspires gaiety."

On the other hand, Jack London:

"I owe the fact that I am still alive, not to any virtue I may possess, but to the circumstances that my constitution is not that of a drunkard and to the extraordinary power of my organs to withstand the onslaughts of King Alcohol. But though I have remained alive I have seen all the others, who were not so happy, pursuing the long and dreary path and finally dying."[1]

Many books and many libraries are filled with opinions on this subject—of all shades: from ecstatic praise of alcohol to its severest condemnation. The latter group is the smallest, and its radical wing which demands total abstinence is also in opposition to those whose slogan is "moderation and liberty," who condemn the vice of alcoholism, but not alcohol itself. Most people think that these last have found the best solution of this great problem.

Nowadays everyone is aware of the injurious effects of alcohol in excess, and experiments are not necessary to demonstrate its poisonous action. Everyone, children included, is familiar with the appearance of severe alcoholic poisoning, i.e. a state of intoxication; the Spartan practice of forcing Helots, members of the lowest caste, to excessive drinking, in order to serve as an example and a warning to the Spartan youths, is no longer necessary. The Saturday and Sunday orgy—in the cities at least—has declined in recent years; not but what there is still enough of it. Some-

[1] This passage is not taken from the original, but re-translated from the German version. (Translator's Note.)

times there are drinking bouts without a hangover the next morning—without an awakening at all : drunkenness and death from acute alcoholic poisoning. Lack of restraint, wagers and foolhardiness are the causes, and such cases are not infrequent. In 1925 a peasant drank a litre of brandy in a quarter of an hour, for a wager, and died. In June, 1931, there was a similar case in Pöllau, Styria : a railwayman drank a litre of spirits, fell down unconscious and died shortly after.

A few cases of deliberate murder by means of alcohol are known, and also cases of deaths from this cause due to negligence. A man has sometimes given the brandy bottle to a child or failed to prevent it from reaching for the bottle and taking the fatal sip. Very little alcohol is needed to kill a child. Some of the older text-books of medical jurisprudence describe the case of a six-months-old child to whom two spoonfuls of strong spirit were intentionally administered ; the child died with intestinal hæmorrhage, convulsions and pulmonary failure. In the year 1931—near Leibnitz in Styria—a five-year-old child, son of a publican, died after being given, according to his father's statement in court, " a thimbleful " of Slibowitz. In fact it had probably swallowed about an eighth of a litre of this plum distillate, which contains 40 per cent alcohol. The father was sentenced to six months' imprisonment.

The fatal dose of alcohol for animals has been determined by experiment. Habituation can considerably increase it. A dog unaccustomed to alcohol will die when its blood contains 1 per cent. Horses are also very susceptible to the action of alcohol ; incidentally, they are very fond of a drop of wine or

brandy. A horse, which had been introduced to the pleasures of wine, once broke into a cellar and drank as much as it was able to swallow ; it was subsequently found in a drunken condition lying amidst broken bottles. The cow is also very easily affected, whereas the hedgehog holds its liquor quite well. Insects, too, are subject to the effects of alcohol. One way of catching moths is to smear a mixture of honey and rum on trees at eye-level. The moths are attracted by the smell, taste the intoxicating mixture, are befuddled by the rum, stick to the honey and are unable to escape.

The poisonous action of ethyl-alcohol—normally the active principle of alcoholic beverages—is sensibly augmented by the admixture of other alcohols, such as methyl-alcohol, for example. Fatal poisoning is often caused by methyl-alcohol in factories where it is used, or where it has been drunk through negligence or by accident. The great catastrophe which occurred from this cause in Berlin—in 1911 about Christmas time—is well known.

The first cases occurred on Boxing Day, 1911, in a Berlin municipal shelter. Twenty persons were taken ill, of whom seventeen died in the course of the night. The poisoning was first attributed to bad fish, and it was established that certain of those affected had eaten smoked herrings bought in a shop nearby. One of the first newspaper reports described the incident as follows: "The men were taken ill at intervals of from ten to fifteen minutes ; the first symptom was in every case dizziness. After this the sufferers jumped up suddenly and were attacked by violent vomiting and cramps. Only one and a half to three hours passed between the onset of the illness and death."

By the 28th December the number of fatalities had risen alarmingly. On that date the results of the autopsies were available, but these, as the doctors stated, gave no support to the view that they were cases of meat or fish poisoning. The problem seemed insoluble. On the 31st December methyl-alcohol was suggested for the first time by one of the doctors. His views were received with scepticism. There had been no practical experience of methyl-alcohol poisoning, though tales of it were known. It was said, for example, that in Russia at a wedding vodka had been drunk containing methyl-alcohol and thirty persons had died.

The suspicion that the poisoning in Berlin had been caused by methyl-alcohol soon proved to be correct. The public-houses in the neighbourhood of the asylum were closed and the cases of mass poisoning ceased. It was found that the fatal spirits had been sold by four publicans who had been supplied by a travelling wholesaler, of whom it was established that between 1st November and Christmas he had purchased 2300 kilograms of methyl-alcohol from various manufacturers and re-sold them. How many besides the inmates of the shelter suffered was never established ; most of the customers of these public-houses were homeless and vagrant people.

At the Eighth Congress of the German Institute of Medical Jurisprudence, Professor Strassmann made an interesting report on these occurrences. He had performed the autopsies on thirty-two of the cases ; there had been ninety-two deaths altogether, excluding the cases in which there was any doubt that death had been caused by methyl-alcohol poisoning. Autopsies had not been ordered in all ninety-two cases, as in most of

them the cause of death had been obvious. The remaining thirty-two included men of every age, the youngest twenty-five, the eldest seventy-six. They had died in various circumstances, some in hospital, some at home, others in the street or in cafés, some in the shelter, others in barns. The symptoms were fairly similar ; nausea, vomiting, colic, loss of consciousness, defective respiration, rigidity of the pupils, and a bluish complexion ; before death many complained of almost complete blindness.

No clear and consistent picture of methyl-alcohol poisoning was obtained by the post-mortems. Blood congestion in the meninges and internal organs, convulsive contraction of portions of the intestines ; otherwise little of note. Chemical analysis established the presence of methyl-alcohol in almost every case. It happened that many of the corpses were exhumed and dissected some weeks after the accident, which makes the value of the results obtained by these examinations somewhat questionable.

The discussion which followed the report was, however, very interesting. Professor Ziemke, the Kiel forensic expert, referred to experiments that had been carried out in his institute on the effect of methyl-alcohol poisoning in animals. Methyl-alcohol procured from dispensing chemists was administered and the animals instantly succumbed. It then occurred to Ziemke to use chemically pure methyl-alcohol. This was obtained from a chemical manufacturer and, remarkably, the dogs to whom it was given remained free from toxic symptoms, even when—given over a period of months—they imbibed more than a kilogram in all.

It appears, then, that methyl-alcohol is not so harmful as was believed and that its toxic action is due to some impurities ; and similarly that what is usually designated and sold as methyl-alcohol is very rich in these impurities. In spite of its topical interest, this question was not entirely cleared up at the time. Possibly absolutely pure methyl-alcohol is no more harmful than other alcohols, but in practice it is not obtained in the pure state. Incidentally, Professor Strassmann is strongly of the opinion that even absolutely pure methyl-alcohol is a poison, and recent investigations support this view.

It is common knowledge that even ordinary alcohol is a poison and that its effect varies widely in different people ; degress of natural sensitiveness and habit are determining factors. Some feel the effect of a single glass of beer, while others can tolerate enormous quantities of alcohol in whatever form—though there are naturally limits. The effects of acute alcoholism —intoxication—are well known. Sometimes they are fairly harmless and take the form of merriment, weeping, excitement or somnolence ; sometimes there is genuine poisoning, disturbing to behold and calling for therapeutic measures. Chronic alcoholism may cause a number of disorders affecting the stomach, heart, kidneys or nervous system.

A number of mental derangements are caused by alcoholism. Delirium tremens, or " the horrors," is an acute manifestation. An habitual drunkard falls ill with fever, suffering perhaps from pneumonia. He is brought to hospital and well cared for, but naturally no one gives him alcohol, no one is aware how much liquor he is accustomed to take. He then becomes

restless and increasingly delirious, sees mice and dwarfs, believes himself in danger and is frantically active. At length he becomes unmanageable and has to be strapped down. A few days' sleep follow and he wakes up cured.

Alcohol also causes other forms of mental derangement. One condition is known as acute alcoholic insanity, where the sufferer hears voices, reproaching, abusing, threatening. This usually lasts some weeks.

The ordinary form of intoxication needs no description, but in pathological cases the sufferer's conduct may be uncontrolled to the point of extreme brutality, often in violent contrast to his normal behaviour, and may bring him into conflict with the law.

Even " normal " inebriation can also lead to excesses and acts of brutality, as every woman who has been unlucky enough to marry a drunkard knows to her cost. She then seeks means of curing her husband and often turns to secret remedies—drugs that can be insinuated into food or drink, and are alleged to cause the consumer to find alcohol disgusting. Alas, she tries in vain ; most cases can only be cured, if at all, by institutional treatment.

In view of the social and economic ills and damage to health caused by alcoholism, it is not surprising that drastic measures are sometimes favoured and that there have always been opponents of alcohol. However, total prohibition—begotten of the spirit of Puritanism—has only been tried in the United States of America. It is well known that vigorous measures had to be taken to enforce prohibition there, and to what evasions and abuses it led. Its whole history would form an absorbing story.

CHAPTER VII

COCAINE

Had Freud not gained international renown by founding the study of psycho-analysis, it is possible that he might have become a disappointed and embittered man. In 1884 he missed a chance of becoming famous by as narrow a margin as a man misses wealth who has rejected a winning lottery ticket. He was on the verge of discovering that cocaine is a marvellous medium for rendering flesh insensible to pain—but he was occupied with other matters.

His own description of the circumstances in his autobiography is as follows :

> " In Autumn, 1886, I took up the practice of medicine in Vienna and married the girl who had waited for me in a distant town for more than four years. I realise now that had it not been for my fiancée, I might have become famous at a very early age.
>
> " In 1884 I felt a profound interest in the little-known alkaloid cocaine and procured some from Merck in order to study its physiological action. In the midst of this work I suddenly found myself able to take a holiday and visit my fiancée, from whom I had been separated for two years. I brought my investigation of cocaine to a rapid conclusion and mentioned in my report that new uses would soon be found for the drug. At the same time I suggested to my friend, L. Königstein, the oculist, that he should test the practical utility of the anæsthetising effects of cocaine on diseased eyes. On returning from my holiday I found that

instead of him, another friend, Karl Koller (now in New York), to whom I had also made communications about cocaine, had carried out the decisive experiments on the eyes of animals and demonstrated them before the Ophthalmological Congress in Heidelberg. Thus Koller is rightly held to be the discoverer of local anæsthesia by means of cocaine, which has become so important in minor surgery. However, I do not bear my wife any ill-will for what I missed."

Dr. Koller ("Umschau," 1931) describes this important discovery as follows :

"Until 1884 there was no practicable method of local anæsthesia. Since it seemed to me that to discover one would be a valuable achievement—particularly for operations on the eye, where full consciousness and co-operation on the part of the patient are desirable—I undertook in 1882 a series of experiments in Solomon Stricker's laboratory. There were a number of keen young men working in this laboratory, among others, Sigismund Freud, Julius Wagner von Jauregg (who later gained the Nobel Prize), Gustav Gaertner, and myself. None of the substances I investigated gave satisfactory results, and at length I gave it up. At the same time, however, one significant result had been attained : I was prepared to seize the opportunity if by any chance a drug showing signs of being effective should come my way.

"Now we had in fact been in possession of an excellent local anæsthetic for the past 25 years, and it only remained for its beneficial properties to be applied. In all text-books of physiology and pharmacology cocaine was described as a drug that apart from its remarkable action on the central nervous system and psychic phenomena, also

paralysed the sensory nerve endings, in fact, rendered them insensitive. But it occurred to no one to exploit these useful properties, possibly because they were overshadowed by the drug's amazing effect on the organism as a whole. Dr. Scherzer, who sailed round the world with the Austrian frigate *Novara* as commercial adviser, first brought coca leaves to Europe and handed them over to the chemist Wöhler. The latter left it to his assistant Dr. Albert Niemann to extract the active principle. Niemann named the alkaloid 'cocaine' and in 1860 observed that it destroyed sensation in the tongue and lips.

"In the Spring of 1884 Dr. Joseph Breuer and the young Sigismund Freud attempted to treat morphinism by substituting cocaine for morphia. The experiments were unsuccessful, but they led Freud to investigate the action of cocaine on the central nervous system. Among other things he asked me to co-operate with him in a series of experiments on the effect of cocaine on muscular energy. (At that time we were both assistant doctors at the General Hospital and saw each other daily.) To this end it was necessary for us to take the drug and carry out observations after a certain time. As mentioned, it had already been known for 25 years that cocaine produced desensitisation of the lips and tongue, but by chance it had never come under the notice of anyone interested in these particular effects. As a consequence of the experiments mentioned earlier I was in a position to do so myself.

"When I made my experiments on the eye and sent my 'Interim Report' to the German Ophthalmological Society in Heidelberg (15th September, 1884) Freud—as he has repeatedly explained—was not in Vienna, but in Hamburg. It is true that cocaine came under my notice through

Sigismund Freud ; and without this concatenation of events I should not have found what I was looking for."

Thus it was that Koller did the work that Freud was too busy to attend to ; in any case the anæsthetic effects of cocaine were discovered at that time, though Koller at first only thought of it in connection with ophthalmology. Here, however, it was invaluable. Nowadays one can hardly imagine how an oculist was able to work without cocaine. A small foreign body has to be removed from the cornea ; a few drops of a solution of cocaine—and a few minutes later the cornea can be worked on with instruments and the foreign body which has been seriously endangering the eye is safely removed. Formerly the difficulties must have been enormous, considering the extreme sensibility of the cornea and conjunctiva. All the lesser operations on the eye—even operations for cataract—are now carried out with the help of cocaine (or latterly less toxic preparations such as novocaine) and general anæsthesia (narcosis) is only necessary for major operations.

Similarly the laryngologists eagerly seized on cocaine. Like the oculists they had to contend with special difficulties ; for any contact with the throat or larynx—such as examination by the laryngoscope—causes a pharyngeal (choking) reflex, which impedes diagnosis and treatment of disorders in this region. Koller's discovery that a solution of cocaine produces insensitiveness put this branch of medicine on an entirely new footing.

Soon after this cocaine was taken up by surgeons. Cocaine solution was injected subcutaneously and found to produce local loss of sensation. Halstead of

New York was the first to use it for the extraction of teeth, not by applying it to the skin surrounding the tooth, but to the nerve which served it. Wölfler used cocaine more and more in minor surgery, and the drug gained a firm hold. The only disadvantage lay in its high toxicity, and if much of the usual 5 per cent solution was used—this was the customary solution at the time—there was the risk of introducing excessive quantities of cocaine into the body.

However, a radical change was brought about by Karl Ludwig Schleich, a doctor of great vision, who in 1892 was turned out of a conference of surgeons amid tumultuous scenes when he explained his method. Subsequently he was triumphantly rehabilitated. Schleich used a solution of cocaine twenty times weaker than was customary, and injected this into the projected region of operation so as completely to infiltrate the tissues ; thus the toxic effect of the drug was almost entirely eliminated and major operations could be carried out without resort to general narcosis. The Schleich solution had made painless operations possible.

Cocaine, however, is of more than pharmacological interest. It is also a poison and one of the most important habit drugs. Cocaine was not discovered until coca leaves had been known for centuries. The first record of these was in 1532, when Pizarro and his two hundred conquered Peru. Among the many rare and valuable things they found there were the leaves of the coca plant, which were held in high esteem by the natives and which the Spanish conquerors soon found to possess marvellous properties, being capable of satisfying hunger and giving new strength to the weary. The people chewed them when tired or oppressed by

sorrows, placed them beside dead bodies in the grave, and offered them to gain favours from the gods ; they were also used at every festivity.

Many explorers have commented on the pleasurable effects derived from coca leaves by the South American Indians, and some who have tried them themselves testified to their potency ; thus Moreno y Maiz attributed to coca leaves " the most delightful moments " of his life.

The quantity taken appears to have varied. The more moderate chewed about thirty grams of leaves, that is about one-fifth gram of the alkaloid ; the addicts took three or four hundred grams of leaves daily, thus a considerable quantity of cocaine, and deteriorated in body and mind, whereas the others were more or less unharmed.

The undesirable effects of coca leaves were soon observed by Europeans, who attempted to combat them, but soon realised that if they were to exploit the land and its inhabitants to the fullest extent it was best to leave them to their indulgence and so increase their readiness to work. Thus the consumption of coca was maintained in South America and is still pursued in the same manner as it was at the time of Pizarro. Peru and Bolivia consume some millions of kilograms annually.

The coca plant, *Erythroxylon coca*, grows to a height of about five feet. The active principle is contained in the leaves. The cultivation of the plant is of considerable economic importance to the countries where it grows, Peru, Bolivia, Columbia and Brazil, and also the West Indies and the Dutch Indies. The leaves can be harvested once and in some districts twice or

even three times a year. The plant becomes exhausted in eight to ten years. In South America the active principle is extracted from the dried leaves and exported in the form of crude cocaine. In Germany the coca leaves from Java are preferred. Nowadays it is possible to produce synthetic cocaine.

The great problem presented by cocaine lies neither in its interesting history nor in its supreme importance in medicine, but in its abuse. Cocaine addiction is the ineradicable accompaniment of the drug and overshadows its good qualities.

It is an unhappy thought that cocaine addiction came into the world through an attempt to cure morphinism. The first reports of cocaine poisoning followed soon after Koller drew attention to its analgesic action and it had been found that with its aid operations could be carried out painlessly. One of the first was the case of a doctor named Kolomin who removed an abscess in the large intestine under cocaine anæsthesia. The patient died half an hour later from cocaine poisoning. The doctor committed suicide. A number of cases of acute poisoning were reported after this, but these decreased considerably after the discovery by Schleich.

Subsequently it occurred to an American doctor to treat morphine addicts by withdrawing their drug and substituting cocaine. This was successful inasmuch as when taking cocaine the severe depressive condition caused by morphia was replaced by good spirits and exaltation. By the time it was realised that a new class of unfortunates—cocaine addicts—had come into existence, it was unhappily too late, and there were already a number of keen followers. Out of the harm-

less chewing of coca leaves by the South American Indians was born a malady of the whites—a pestilence which claimed innumerable victims.

A few years before the War, Meister, an American army doctor, had his attention drawn to a few soldiers who collapsed several times during manœuvres, although they were strong, healthy men. It struck him as curious, and he decided to look into the matter. He found a very surprising thing for the North America of that date : these men had been taking cocaine. The cases centred round a particular mess and the originator of the epidemic was finally discovered to be one of the soldiers. He in his turn asserted that his source of supply was a prostitute.

This cleared up the incidents at the manœuvres, but surprise remained that they should have taken place at all, as such practices were then almost unknown in the United States. Europe was far ahead in this respect, and in this case Europe meant Paris. In Paris attention had already been drawn to the extensive abuses of cocaine, and even before the War police raids were organised, principally in the Montmartre Quarter, in attempts to capture the illicit dealers in " Koko." The raids uncovered the personalities of those who were themselves addicts and were suborning others. They were a heterogeneous community : manual and intellectual workers and those without work ; people who had " seen better days," others very near the gutter ; the diseased and the still healthy ; the poor and the almost completely impoverished. They formed a little company—rather like a secret society—the members of which were acquainted, were friends or enemies of each other. They were

joined by their devotion to one cult—that of a white powder contained in a little box or a fold of paper which brings momentary happiness and misery for the rest of life. These were the first Parisian cocaine addicts, the first to succumb to this pestilence ; from them it spread all over the world.

There have naturally been many patients taking cocaine under medical direction who have come to find it more than an anodyne. There were also morphinists who were given cocaine in an attempt to relieve them of their craving. These were the first seeds of cocainism whose roots rapidly spread, so that there are now many who know nothing of the original use of cocaine, but only know it as a form of self-indulgence.

With morphia the case is somewhat different. It is usually in cases of intense pain that people are introduced to this benevolent drug ; and then the acquaintanceship sometimes develops into a deadly friendship. Cocainism, on the other hand, as a rule starts by curiosity and love of sensation ; addicts entice others, or people become cocainists first by copying their friends, just as smokers do ; and in the same way as the first cigar only causes disagreeable sensations, so it is with the first doses of cocaine ; but nevertheless the poison takes hold.

Cocaine addiction first became a large-scale menace during and immediately after the Great War. The reason is not hard to find, for in that period of physical and spiritual need, many people's nerves failed them and they readily seized on the fashionable drug, which was easily procured through illicit dealers eager to exploit such a profitable weakness. After the Armistice large quantities of the drug leaked out of the

Army supplies, were clandestinely appropriated by those with some understanding of pharmacy and turned to profit. For at that time one of the chief questions was to get money for nothing. Thousands were greedily eager to absorb the cocaine and hundreds arose to supply them with it for money—for a great deal of money. Like the War this brought death and destruction.

Incidentally it is clear from many modern reports that the practice of chewing the coca leaf is just as prevalent in South America as it was centuries ago.

Richard Katz, who visited South America in 1930, gives the following description :

> " It is sunrise, but the thin air has quickly absorbed the warmth. The people come out of church sadly and silently, the men in their brown ' ponchos,' the women in black mantillas. They disperse immediately, some to the cellars, to imbibe the fresh, still stinking sugar-cane spirit, others to the women from the ' Montanja ' who sell coca leaves. The holiday begins and ends with spirits and cocaine. At least fifty thousand Indians come to town for this fair ; but it is probable that only spirit merchants and cocaine sellers make a profit. Anyone who sells anything else spends what he earns on drink, and those who sell nothing exchange their goods at half their value for spirits and cocaine. At the entrance to the fair nothing is to be seen but coca—great piles of it like dried laurel leaves. The women dealers squat there with heaps of coca leaves in their laps.
>
> " The coca plant grows wild in Peru and is consequently sold cheaply, costing only two or three shillings a pound. The natives cover their requirements for a month at a time—one to four pounds, according as they only chew it at odd

moments or have developed a continuous habit. They smear lime on the leaves in order to release the poison more freely.

" Many people in this part of the world consider that the moderate chewing of the leaf is no worse than moderate smoking ; and among them are not only the farm (hacienda) owners—who know that no Indian could carry a two-hundred-pound sack without the stimulation provided by coca—but also unbiased scientists. A German botanist in Lima told me he sometimes chewed the leaf himself when mountaineering, and even drank infusions of it occasionally without experiencing anything but stimulation. He maintained that the cocaine content of the leaves was too small for their chewing to be comparable to the sniffing of the pure drug. I myself chewed the leaves as an experiment and can confirm that this produces a sensation of well-being and banishes fatigue. But it banishes subsequent sleep too. It enlivens one, but to my mind too much so to be healthy. A doctor here told me that coca chewers were very susceptible subjects—and a farm-owner stated that the really devoted coco-chewers were the first to succumb to epidemics.

" Obviously the habit really does become a passionate necessity ; otherwise the aged, barefoot Indian would not barter his two sugar canes, brought as his daily ration, for the wares of the coca woman. The woman smells and fingers the canes before throwing a handful of leaves in the old man's hat. He does not, however, immediately take back his hat, but with moist-eyed gaze implores her for more. The market woman turns away to gossip with friends. Sometimes the little girl, carried in a shawl on the woman's back, secretly reaches over her mother's shoulder to the pile of leaves and gives the old man another little handful, and he shuffles

away satisfied ; he has nothing to eat, but has something to chew, which is apparently more important. Those who come to market have to pass by coca and spirits stalls. Not till these are past are other commodities to be found."

Glaserfeld, in 1920, was one of the first in Germany to draw attention to the fact that Berlin had become a centre of the cocaine traffic. It was soon established how right he was and that a large number of dispensing chemists and still more street dealers were selling " coke," as it was known to its familiars. A flourishing " industry " had developed, an illicit trade which made enormous profits, for purchasers usually obtained only a tenth of the value of their money ; the cocaine was almost invariably diluted and sometimes almost entirely replaced by bicarbonate of soda, salicyl, boric acid and other substances. The United States—in particular New York and Chicago—Paris and Berlin, closely followed by the other capitals, were the main centres of these malpractices.

As the international character of this new vice became recognised, various countries united as far as possible—for example, in the League of Nations—for the purpose of taking collective action. The first problem was to combat the illicit dealers and smugglers, and it must be admitted that a decrease of cocaine addiction soon became evident. It is, of course, impossible to give figures showing the number of addicts, but the approximate extent of the vice is known. There has been a decline since the highest figures were reached in the years 1920–1924, though it will never be possible to stamp out the vice entirely—not even if its production is forbidden altogether.

Cocaine addiction as now generally understood is a very different matter from the chewing of coca leaves. Paul Mantegazza, who in 1859 published a prize essay on the chewing of coca leaves, admitted to being an enthusiastic adherent of this South American practice, and the Peruvian Indians have always known and still know how to appreciate the pleasant effects of the coca leaf.

As to cocaine itself, those who are dependent upon it and even those who have been able to lay aside their death-dealing vice testify to the agreeable sensations it produces.

It is easier to describe the pleasurable effects of this drug than that of many others. Whereas it may be hard to say why one enjoys a cigar or longs for alcohol, there does not seem to be the same difficulty in regard to cocaine. A saltspoonful—perhaps a tenth of a gram to begin with—is introduced into one nostril and inhaled while the other nostril is held closed and then—apart from the first attempts, which generally produce nausea—in a few minutes the desired effects set in. Increased vitality and a feeling of contentment with the world are experienced ; sorrows are forgotten and life seems rosy ; fatigue is non-existent and one feels capable of anything ; bodily and mental apathy disappear ; one is ready to create—write poetry or dance, and is consciously happy. This lasts for twenty to forty minutes and then comes sobriety followed by one or perhaps two sleepless nights, and sometimes forgetfulness of what has happened.

If the effects last longer—several hours or a whole day—it is clear that more than a single dose has been taken—probably a great many, and larger quantities. Over-excitement follows, even delirium and a condition

of intoxication resembling hysterics and the effects of over-indulgence in alcohol ; this persists for several days.

It is, of course, not known how many people there are who have only once indulged in cocaine, who have just " tasted " it and then never repeated the experiment. But probably there are only very few. Some take it on special occasions ; actors in order to overcome stage fright, or speakers afflicted with shyness, sometimes sniff a little cocaine as others might take a drink. These are the mildest of chronic cocaine addicts ; the drug has not completely mastered them and they are able to dispense with it entirely if they take a little trouble, particularly if they can find an effective substitute.

But a very large army of cocaine takers is permanently enslaved and its members present every phase and symptom of chronic poisoning. The chronic addict is a pale, weak-willed creature, bodily degenerate and given to hallucinations. When he is under the influence of cocaine, the symptoms of poisoning predominate ; if he happens not to have taken the drug for the moment, he suffers from the deprivation, complains of a feeling of oppression, loss of sleep and palpitations, until he can once more obtain the drug and replace one discomfort by another.

Lack of restraint is one of the chief characteristics of the cocaine addict and it becomes most evident in his attempts to procure the drug. These people become capable of any outrage or crime—even murder, if they lack their drug and are forced to do without it. This lack of restraint is particularly evident in their sexual relations. In this connexion it has been observed that the erotic activity of woman is increased and that of men decreased by cocaine. Moreover there appears

to be a connexion between cocaine and homosexuality : it has been noticed that homosexual proclivities have emerged in cocainists who were formerly normal in their sexual life. These phenomena have frequently been observed, but no satisfactory explanation is forthcoming. The increase of active power engendered by acute cocainism (concerning which Professor Hans Maier of Burghölzli has made some interesting experiments) is soon reversed in chronic cases ; restlessness conceals the condition at first, but a little while later it becomes apparent that the sufferer is no longer capable of sensible work.

The increased vitality and feeling of joy soon passes ; it is replaced by disgust and depression ; nothing but craving for the drug remains. Severe bodily symptoms also emerge ; paralysis and further a remarkable affection of the nose in which a painless tumour on the septum is formed, which eventually works its way through, making a hole in the septum. This manifestation is connected with the method of taking the drug ; the sniffing renders the mucous membranes of the nose insensitive and hence prone to infection.

The psychic symptoms of the chronic cocaine addict are the most important ; the mental aberrations that follow, the hallucinations and terrors which beset him, are infinite in number. He sees small objects, famous personages, often diminished in size, coloured objects, fantastic apparitions where a man suddenly changes into an animal, dazzling lights ; the room turns round ; whatever he thinks of, appears to him ; he feels ants beneath the skin, worms under the tongue, bugs, lice and insects of all sorts. He hears voices calling to him, music, revolver shots, abuse and threats. These addicts become violent ; tear off their

clothes ; attack strangers ; shoot—and unfortunately often hit, for—in the early stages at least—their hand does not tremble. Further they are jealous, filled with hatred, ready to kill themselves and others. Their life is made up of illusions. They become discoverers and inventors, martyrs and heroes. Then they forget everything, even things that happened an hour earlier, things they have done themselves, who they are ; and even if the delusions are not complete and a little of the critical faculty remains, they are still not capable of carrying out what the reasonable part of their mind orders, but rather obey the other part, though they know it to be illusion. They are incapable of resistance. Their home is the lunatic asylum.

There are some who pass through this purgatory and return to the outer world cured—sometimes even permanently cured. But there is always great danger of relapse, the smallest temptation usually suffices to drag them back into the mire.

Naturally everyone who feels any responsibility in regard to this affliction, professionally or otherwise, does his utmost to control it. The horrible experiences with addicts, the indelible impression made by the suffering, the misery of individuals, of whole families, make this a duty. Never—this may be safely assumed—can there be anything in our part of the world which will cause such terrible devastation as the white powder called cocaine. True—all forms of drug addiction are injurious—each provides its own particular form of misfortune. But cocainism is the deepest of all hells, and one is almost ready to curse a substance whose mission it once was to serve suffering humanity, to be an item in the world's collection of medicinal treasures, superb in its effect, a divine gift to man. . . .

CHAPTER VIII

OPIUM

Claude Farrère conceives opium as a god, shrouded in mystery, who at nights appears to the Emperor of China—also a god—and presents him with the opium pipe, the heavenly gift, which enables him and his people to perform tasks for which otherwise their strength would not suffice.

Unromantic science perceives it differently. It sees a man thousands of years ago who once by chance tasted the juice of the poppy and was the first of millions of men who succumbed to the magical effects of opium. It is immaterial whether the seeds and poppy capsules found in pile-dwellings in Western Europe in fact indicate that the plant was cultivated in order that poppy juice might be extracted from it. In the Odyssey, which is old enough, even though it may not go back to those times, Helen throws " into the wine they drank a drug to drive forth grief and sorrow and all memory of suffering." This can only have been opium, as Lewin rightly assumes ; no other substance in the world has the effects so characteristically described in the Odyssey.

From that day—so many thousands of years ago—to this the juice of the poppy has flowed in an eternal stream parallel with humanity's eternal sufferings and its no less permanent irrationality, which has always been ready to turn a blessing and a relief into fresh vices and tortures.

On Egyptian papyri, in the Greek and Roman

classics, in Arabic and Persian writings, in medical works of a later period, in the writings of Paracelsus, there are continual references to the soporific juices of the poppy and the wonderful dreams it brought. "I have a secret remedy, which I call Laudanum, it is without equal for those who would flee to Death," writes Paracelsus; of whom it is assumed that like many doctors of every period, he had himself succumbed to opium.

The poppy, with its bristly stem, brilliant flower and round capsules, is at once a great blessing to mankind and a great curse. The seed capsules, two or three inches in diameter, contain the active principle. If one scratches the unripe capsules a small quantity of juice exudes and rapidly dries; it is a milky juice, such as many other plants have. But the milky juice of the poppy is opium, meconium or laudanum as it was formerly called. Each capsule only contains a small quantity, not more than a fiftieth of a gram.

The peasants in Asia Minor cultivate the poppy in fields. Before the plant is ripe, they make a small incision in the capsule in the evenings. The juice runs out and is carefully taken off and collected the next morning; it is then kneaded into a reddish-brown cake or globule and wrapped in poppy leaves. This is the opium of commerce. It is by no means pure, and contains water, resins and sugar, but also 10 to 20 per cent opium in addition to other narcotic substances —e.g. narcotine, codeine—and other alkaloids.

Opium eating is much older than opium smoking. It is hard to say if there is much difference between the two where the physiological action is concerned. In some countries one and in some the other is more

prevalent. In either case it means uncompromising serfdom and is a dearly-bought indulgence. The opium eater swallows one or more pills and after an hour he is under its influence, which lasts for several further hours. Some addicts are content with the same dose for a long period, but most increase it as far as their income allows. A daily dose of several grams of opium is not unusual. Instead of pills an extract is sometimes preferred, the well-known tincture of opium or one containing saffron.

In all Oriental countries opium has been the favourite drug for many centuries, and thence it has spread westwards.

In 1822 appeared the famous *Confessions of an English Opium Eater* by Thomas de Quincey, and from it we are able to deduce that opium eating was fairly common at this period. Opium was cheaper than alcohol and on Saturday afternoons the chemists' counters were heaped with the pills. Not only in London, but also in the large manufacturing towns of England there were many people—mainly artisans—given to this vice. De Quincey, as he tells us, on the advice of a friend, first took to opium because he was tormented by toothache.

The first few years he did not take opium regularly, but only on occasion, and was most enthusiastic about it. But his attitude changed when, after eight years, he suddenly began to eat opium every day. He then began to feel the ill effects. He took about twenty grams of the tincture daily, but succeeded for one whole year during this period in reducing the dose to about one-eighth of that quantity. But only for one year. He then returned to his daily dose, that according to his

account corresponded to eight thousand drops, and his sufferings from the drug returned. He records them in detail : hallucinations and visions as of a stage inside his head on which there was a ceaseless performance of ever-changing plays ; intense melancholy and black depression ; aberrations of the sense of time and space —he would imagine, for example, that he had passed not one night but seventy—or a hundred—years ; childhood memories would suddenly arise from the depths of his mind to plague him.

These agonising dreams and hallucinations at least had one good effect : they helped him find the necessary energy to reduce his excessive doses. He writes that he realised that opium would kill him if he continued with it, and he managed to gain the upper hand. To begin with, the abstinence phenomena were severe ; after four months he was still suffering extreme nervous derangement, twitching, a galloping pulse and a sensation of oppression. No medicine gave any help, with the exception of ammoniated tincture of valerian. He then confined himself to the relatively moderate doses of about a hundred drops of opium a day. Once, in 1848, he remained for two months without opium —probably the longest fast in his life.

He died in 1859 at the age of seventy-three. Shortly before his death he summarised his story by stating that once one has succumbed to opium, it is best to try and reduce the regular dose to the smallest possible quantity and by constant discipline keep to it and take regular exercise in the fresh air. He believed nervous over-excitement to be the hidden canker of humanity and that opium was probably the only palliative.

That was some time ago. If de Quincey was right and excessive nervous excitement was the true cause of opium addiction, the whole world would be a poppy field by now. In spite of the wide extent of this habit, opium addiction among Europeans is restricted to a small fraction of the population. It is most prevalent in ports and large cities.

De Quincey's description of opium symptoms has become classic, and gives an excellent summary of the case for and against. Moreover the quantities of opium he took are common to many addicts. They are large, but even larger doses are not unknown. Twenty grams of the tincture is, of course, a great deal, particularly when one reflects that a fraction of a gram is enough to cause poisoning. As with all poisons it is a question of habituation and sensitivity.

Young children are particularly sensitive to this poison, and it is important that this should be borne in mind, since in villages and slums it is common to find mothers who calm a howling child with a decoction of poppy pods. Many children must have come to harm and even lost their lives through this, though only a few cases have become known. It is recorded that in Vienna a case came before the courts where a child had drunk a decoction of three poppy heads. The child, who was one year old, died within one hour. Unripe poppy seeds (the ripe ones are well known to be harmless) sometimes cause poisoning.

A large number of deaths caused by tincture of opium occur through negligence or pure accident. An eighteen-months-old child sucked the cork from a bottle of tincture of opium. Half an hour later the child fell asleep never to wake. On the other hand the

case is known of a three-weeks-old child, who, owing to a mistake, was given five grams of opium tincture—an enormous quantity for a child. The child became dazed, suffered convulsions and the action of the heart ceased periodically ; it recovered, however. Adults manifest the same variability : one person may die from taking a third of a gram of opium extract ; another accidentally takes ten times as much and suffers nothing.

There are occasional suicides from opium ; but morphine, the active principle of opium, is nowadays more usually chosen. Opium poisoning was even known in ancient Rome, but was not much used for murder ; or at least not many cases of this kind are known. Other poisons were more popular for the purpose.

There is a case on record in which tincture of opium was used for murder. In September, 1892, a doctor was called to a woman ; he found her unconscious, and she died after a few hours. The doctor found the cause of death to be obscure, could not eliminate the possibility of poisoning, and recommended an autopsy. This produced no conclusive results, but the possibility of poison was once more recorded. The woman was found to be pregnant.

The police enquiries revealed further evidence which strongly incriminated the husband. At first it was inferred that the intention had been to terminate the pregnancy and that to this end the husband had procured poison for her. It emerged that he had tried to procure arsenic and further that he had maintained a liaison with another girl. The woman's body was exhumed in January and once more examined. A few grains of corn poisoned with strychnine, such as are used

for rat poison, were found in the intestines. These, however, were not the cause of death. The court assumed opium poisoning on account of the symptoms observed by the doctor in the dying woman—in particular the contraction of the pupils—although chemical analysis had not been able to establish its presence in the body.

The man was condemned to imprisonment for life. He subsequently informed his counsel that on the day before she was taken ill, his wife had obtained from a chemist sixty grams of opium tincture by means of a forged prescription. He was not able to obtain any alteration of the verdict by means of this statement.

Opium pills and tincture, though they provide dreams fantastic enough, are sober things in themselves. Whereas the opium pipe--the Oriental's dream-procurer —seems to the European to be charged with the romance of the East, an embodiment of the tales from the Arabian Nights. In Marseilles and some other European cities mysteriously concealed chambers may sometimes be found, furnished with divans and opium pipes. But here the " opalescent spirit of opium " is lacking.

Hans Heinz Ewers, who contributed a preface to Farrère's novel *Opium,* writes :

> " I find a difference whether I smoke my opium at home, within my four walls in Toulon, Paris or Berlin, or whether I take the black, glowing pill on to the needle somewhere in the East, in a den in Shanghai or on a flower ship on one of the muddy rivers of Southern India. One must have the sensation of China or Huam and Tonkin, not merely know it from the books, but feel it in the tips of one's fingers, before one can know what opium really means."

We possess many accounts of opium smoking and opium dens in the East, where natives and foreigners carry on fantastic orgies and give themselves up to dreams. But precise and authenticated observations are rare. Professor Thoms of Berlin describes a visit to an opium den in Batavia as follows :

" At the entrance stood a tall Chinese with sunken eyes and prominent cheek bones, known as the ' Father of the Hostel.' He also is given to opium smoking. We entered an ill-lighted, uncomfortable, stable-like room with bare flagstones as flooring, furnished with rows of low wooden bunks, divided by narrow aisles. On these smokers lie stretched out on mats. The head is supported by a small wooden block and a cushion.

" It was ten o'clock in the morning when we came in and there were already forty to fifty visitors. Each had a small oil lamp at his side, in which a flame about an inch high burned, enclosed in a small glass cylinder. The smoker takes from a lead tube containing his day's ration a bead of opium the size of a pin-head, using a metal needle heated in the flame, and transfers it into the little opening in the opium pipe. The latter is about 10 inches long, about 1 inch in diameter, and is made either entirely of metal or sometimes of wood ; if of metal it ends in an ivory or wooden mouthpiece. Near the other end is a detachable metal bowl with a small opening for the opium. From time to time the smoker brings the opening of the bowl sideways into contact with the flame and take two long pulls of smoke, which he immediately blows out. He then drinks a little green tea and perhaps lights a cigarette.

" The incompletely combusted opium collects in the metal bowl ; the smoker is expected to retain

these leavings and return them to the 'host,' who sells them to the opium factory, where the opium is extracted. Incidentally, these represent his entire takings; apart from this his 'guests' make him no payment.

"Most of the men in the bunks were Chinese, with only a few Malays among them. Some of the smokers were sleeping lightly and awoke as we approached them. They looked at us with staring, glassy eyes. Some of them lying with naked torsos on the bunk were extremely emaciated. In one case I was able to observe a considerable over-action of the heart. The smokers were by no means hostile or truculent, but ready to give information about why they took opium and what pleasure they got from it. Most of them complained of defective appetite. One said he became ill if he did not smoke opium daily, and was resentful at the refusal of his frequent demand for an increased dose. To combat the loss of appetite they use an aromatic powder flavoured with galangal and ginger, of which they take an occasional pinch."

The manner of opium smoking adopted by the Chinese of the Usuri district of East Siberia is described by the Russian ethnologist, Professor Arsenjew, as follows:

"An outfit of opium smoking costs thirty to fifty roubles and consists of a metal tray and an oil lamp (Jentyen) with a glass globe, which protects the flame from draughts. All the heat from the lamp is concentrated under the opening at the top of the glass globe. Further accessories are a horn box for storing the opium, a small forceps for regulating the wick, a long needle (Jentschensa) and a small curved knife to removed the charred remains from the pipe. These residues are care-

fully collected in another box and when there is a sufficient quantity it is boiled in water. This produces a liquid the colour of weak coffee which is filtered through blotting paper and concentrated by boiling. The sticky mass remaining is opium, but as it contains impurities, such as ash, it is mixed in equal quantities with pure opium before being re-smoked.

"The chief requisite for opium smoking is naturally the pipe (Dajensthen) itself, which is a foot and a half long. It is mostly made of wood, but more expensive ones are also made of ivory, with carving and silver ornamentations. The construction of the pipe is simple. At a distance of about two-thirds of the length of the tube from the mouthpiece there is a small opening the size of a small coin ; this is meant to hold the bowl (Dajentan) which is small and may be angular or rounded. It has a flat, slightly rounded, hollow top with a small hole leading to the tube.

"Fairly elaborate preparations are required for smoking. To light the pipe, if one may use the term for this complicated proceeding, the Chinese lies on his left side, so as to leave his right hand free. The burning lamp, covered by its glass globe, stands on a shelf beside him. The long needle is heated by the lamp and then dipped into the opium box. The finely powdered opium fuses itself into little beads and adheres to the hot metal. Alternatively, if the opium is not entirely dry and in a solid piece, a little is cut off and impaled on the unheated needle.

"In this district raw opium is often used and the moisture evaporated over the lamp. Here again only a small portion is held on the needle. Blisters form and it begins to boil. The needle is constantly rotated and the viscous fluid prevented from falling. Now and then the smoker takes the

needle out of the flame and rolls the opium a little on the palm of his left hand. He then warms it again until the opium forms no more blisters and the rising vapour has acquired a particular colour and smell. It is then ready ; the smoker rolls it once more in his hand without removing it from the needle and makes it into a small oval pill, sharp-pointed at one end. He warms the bowl of the pipe slightly, introduces the opium pill into the bowl by its pointed end and by means of the needle, whereby the sticky opium adheres to the bowl. Next the needle is carefully withdrawn. It only remains to fix the bowl into the tube and the apparatus is ready for use. The hole in the opium pill now connects with the passage into the tube.

" While it is being smoked the pipe is held in the left hand and the opium is often re-warmed in the lamp. It boils, splutters, steams, swells up, ignites and then goes out. The smoker draws in the smoke vigorously through the mouthpiece, his whole attention being directed towards preventing the blockage of the hole, which he keeps open with the needle.

" When one pipe is finished, another is lighted ; then a third and so on until satisfaction is attained.

" Usually these places only possess a few sets of utensils, which are consequently passed from hand to hand. These Chinese smoke opium to escape from the joylessness of their daily life into dreams of delight ; to gain forgetfulness of the poverty and misery around them, and often merely to dull physical pain."

The craving for pleasure-giving drugs is universal and their introduction into the body by means of a pipe is by no means restricted to the use of opium. The lustful sensation derived from smoking opium

presumably resembles closely that of eating it, is even perhaps slightly more pleasurable, though the relation between tobacco smoking and chewing is not analogous. There is no doubt that opium smoking is typically Oriental. The essential loneliness of the Oriental gave him opium, the drug of the solitary.

Books dealing with the East tend to stress the magnificence of the surroundings in which opium is smoked—rooms with swelling cushions on which one lies surrounded with the most extreme luxury and immersed in ecstatic dreams. The opium dens described by Professor Thoms are miserable holes.

The State-controlled Batavian opium houses in the humble quarters such as are shown to foreigners, show the opium-pipe in surroundings very different from the palaces where there still exist enormous wealth and fairyland magnificence, which no European sees. But even these typically Oriental pictures are gradually being Europeanised and Americanised.

Excessive wealth and excessive poverty are the causes of the Oriental's craving for opium and the otherwise unobtainable delights and dreams of luxury and forgetfulness it brings ; not to mention those who seek release if but for an hour from bodily pain. For to the addict the opium-pipe is the key to paradise ; the world disappears with its burdens and sorrows and there only remains the ego in full command of the joys of existence—a transient illusion which is followed by the more durable reality of the harm to body and mind engendered by opium consumption.

Opium has played an important part in certain chapters of world history, notably in the events known as the Opium War.

China was naturally early aware of the narcotic and delirient effects of poppy juice. Opium was known there from the eighth century. For centuries the Chinese only used it therapeutically ; its abuse was a later development and was mainly caused by a Chinese emperor who—at the beginning of the seventeenth century—hoped to help his people by forbidding the smoking of tobacco. Out of this benevolent prohibition arose the greater evil ; the irrepressible craving for an intoxicating drug quickly caused tobacco to be replaced by opium, and when the ban on tobacco later fell into disuse, tobacco soaked in opium became common.

From then on the use of opium developed rapidly. The home production was low and all opium had to be imported. The rulers of China soon recognised the danger and in 1729 it was forbidden to smoke or import opium. This, however, did not destroy the desire for opium and an illicit trade combined with smuggling swiftly developed. The prohibitions had to be continually renewed and the penalties augmented. People caught smoking opium were severely punished : with dungeon, exile, cutting off the upper lip and strangling. And it also went hard with the dealers. Sometimes they were cruelly punished, then the official severity was relaxed for a time until further prohibitions and penalties were imposed.

By the beginning of the nineteenth century the situation had altered. Opium was no longer smuggled from Asia Minor and Persia, but was brought among the goods of the powerful East India Company, declared as medicine, but certainly used to supply the smokers. The Chinese officials restricted themselves for a long

time to checking the declarations and imposing a moderate tax on imported opium. In the year 1820, however, they became more strict and forbade its import altogether. Once again an illicit trade arose, but was not tolerated for long. Out of it the Opium War eventually arose.

It was a tragic and shameful affair. A people steeped in an ancient culture and threatened: with decline requires those responsible for its welfare to protect it from a grave danger. A mercantile spirit opposes the movement, hoists the banner of big business without the least pretence, and is strong enough to rally the English to its cause. The Chinese had done what they held to be right and had finally seized a large number of chests of opium—about 20,000—and thrown them in the sea. In 1839, in order to demonstrate that they would no longer tolerate the poisoning of their people, they forbade all trade with English goods. This was the beginning.

Wars—it is true—have been started for smaller things, but this was certainly not a war to be proud of. In 1840 it was over: the Chinese were defeated, and in the peace of Nanking and in the treaty of Tientsin all prohibitions on opium were lifted. In the following years more than 90 per cent of the enormous Indian production of opium was exported to China—there was no restraint on its consumption. The poppy now began to grow and flourish in China, and with domestic cultivation grew the hatred of all Europeans.

The situation then changed again. The hatred remained, but the poppy gradually disappeared from the fields of China and was replaced by rice and grain. In 1906 the treaties were revised and a fresh agreement

was drawn up. China undertook gradually to abolish poppy farming and opium production according to a definite schedule and England undertook to reduce the opium imports in proportion. A people enervated by opium was to develop into a country restored to health that would co-operate in the progress of mankind in accordance with her former tradition. But the sins of many generations were not to be cancelled by a stroke of the pen ; neither were the results of an opium war. China has now reached a point where—officially —she has neither poppy farming nor opium traffic. The smuggling trade however, still widely distributes the drug from India and even more from Japan.

Things have also changed in the Near East. While at an earlier period opium had been almost without rival owing to the Koran's prohibition of alcohol, since the War alcohol has gained in importance for the new Turkey ; with the disappearance of the veil and harems and of many other traditions, goes the decline of opium smoking, particularly in cities.

Romanticism is decreasing on every side and alcoholic excess is far from romantic. Nevertheless, the cultivation of the poppy and the production of opium are of the greatest importance in Asia Minor. The annual output even now must be between 600,000 and 800,000 pounds, perhaps a quarter or a third less than before the War. Though the smoking of opium has declined, its use for pharmaceutical purposes is considerable and has maintained the demand from Asia Minor at a high level. The legal and illegal consumption of morphia has increased, and the poppy farmers in Asia Minor and the middlemen in Constantinople and Smyrna realise this. Almost all the major western

countries and Japan and America are consumers, France perhaps most of all. Statistics regarding opium are always very unreliable.

The production of opium in Persia is probably about the same as in Asia Minor ; here also it is an important branch of industry for landowners and middlemen and a considerable source of revenue to the State. It is estimated that in Ispahan at least a quarter of the population derives its living directly or indirectly from opium. A large proportion of Persian opium finds its way to China where the demand is larger than in other countries. Incidentally, China has another source of supply, Vladivostok, which has recently gained in importance in the opium trade, both as a distributor and a consumer, since it has several hundred opium houses.

In India the opium trade is rigorously controlled ; concessions are necessary even for the cultivation of the poppy. Opium auctions are regularly held in Calcutta. Nevertheless the industry is declining. Incidentally the conditions are not the same throughout India. In Egypt (on the other hand) the cultivation of the poppy is increasing in importance. In Upper Egypt opium is eaten.

In Europe there is also a considerable production of opium. On the Balkan Peninsular it is an industry of long standing. The suitability of the soil for cultivating the poppy has long been recognised, though it is true that tobacco farming produced serious competition. Much opium is grown in certain parts of Yugo-Slavia —in parts that formerly belonged to Macedonia.

The large profits to be derived from the growing of opium—much larger than from corn—ensure that new

territories are constantly being opened up, however little this may be desirable from the point of view of nationally oriented farming. It should be noted that the importance of the poppy in these districts does not lie only in the production of opium from the unripe seeds ; the ripe seeds are a source of oil, which is gradually becoming a rival to olive oil. And since one can derive both opium and oil from a single plant and further use what remains as fuel, its cultivation, which provides work for a whole family, is much favoured by the small farmer. Bulgaria also produces opium, likewise Greece. In these countries the opium production is less favoured than the cultivation of tobacco. Climate, soil, conditions of labour and distributive facilities determine this and control production and sale. London, however, provides the largest market for opium ; it absorbs almost the entire opium output both European and of Asiatic origin, and distributes it to the drug manufacturing industry.

Since the League of Nations has taken steps to combat the abuses of opium and morphia, we now have fairly accurate information about all the countries where the poppy is cultivated and opium is produced, sold or consumed—as accurate, that is, as we can hope to have on this subject which is always more or less veiled in mystery. The foundation of the campaign was necessarily the collection and collation of data. The statistics revealed high figures for opium addiction in a large number of countries.

The Eastern countries have already been mentioned. The report of the Chinese delegate, Wang-kingki, in 1929, before the Opium Commission at Geneva is noteworthy. In the name of his countrymen

he vigorously opposed any compulsion on China to tolerate the smuggling of opium ; he maintained that the principle of free trade could not justify the poisoning of the people. China had for so long been the home of opium smoking that it was understandable that wherever Chinese congregated the opium-pipe was to be found. This is clearly shown in the United States. From the Chinese quarter of New York and other large cities opium addiction spread like any other infectious disease ; the prohibition of alcohol had created increased readiness to absorb poison, and great wealth made it possible to satisfy desire. It is shocking to learn that in North America about 700,000 pounds of opium are consumed annually, which is at least ten times the quantity required for medical purposes. In the United States at least 600,000 pounds of opium a year are simply used by weak-willed people for poisoning themselves.

Compared with the cities of North America, the Asiatic countries and certain districts of Africa, the European consumption of opium is low—though with regard to morphia this does not apply. Even in the ports in the south of France the opium-pipe is rare and generally restricted to a few seamen and decadent women and is of little significance. What is important, however, is the number of smugglers eager to seize all available opium for sale in the places where good prices may be obtained. Once more China takes the first place. And it remains highly questionable whether the conferences and commissions of the League of Nations will succeed in achieving more in this sphere than they have in others.

CHAPTER IX

MORPHIA

Morphia was discovered by Friedrich Wilhelm Adam Sertürner, who has long since sunk into obscurity—though recently his name was recalled. In 1924 it was remembered that a hundred years had passed since the introduction of morphia into medical practice, and a memorial was set up to him in Hanover ; and on this occasion some may have bethought themselves of the time before Sertürner, when men suffered and died without the gift of morphia to alleviate their pain and soften the torments and terrors of death.

The history of morphia is the song of songs of suffering.

Opium, the parent substance of morphia, and its uses, were known thousands of years before Sertürner. Opium takes away pain and brings sleep, and before the time of anæsthetics it was opium that made it possible to relieve slightly the pain of a surgical operation. It can counteract spasms and reduce the excitation of a single organ or the whole body, but in the more important task of alleviating pain morphia is far superior.

The customary tincture of opium contains approximately 1 per cent morphine, which is a hundred times more effective than the parent opium in deadening pain.

The reddish-brown cakes of commercial opium contain a large number of substances known to the chemist as alkaloids ; they include morphine and

codeine groups. Good opium contains at least 10 per cent morphine.

Morphine is a base and like potassium and sodium reacts with acids to form salts, and what is generally known as morphia is the hydrochloride. This property was discovered by Sertürner, but the chemical constitution of morphine was first established by the chemist Liebig in 1831 ; the formula $C_{17}H_{19}NO_3H_2O$ was discovered by Laurent in 1847. It is not the only active component of opium, which contains at least twenty alkaloids as well as fats, resin, mucilage and water.

The advantage of morphia over opium is not merely that it is much more potent. When opium is administered the patient takes not only morphine but the other component substances of opium, which render it less effective in lessening pain and reducing excitement. Then again, what is commonly known as morphia, i.e. salts of morphine—mainly the hydrochloride containing 80 per cent morphia—is readily soluble in water, which makes it easy to administer with the hypodermic syringe. Sertürner's discovery made this possible, but it was a long time before doctors overcame their reluctance to adopt the method.

It would be incorrect to imagine Sertürner an unhappy, embittered man because he had to wait some years for recognition ; nor are his contemporaries much to blame for their hesitation. It has been thus at all periods, and scepticism is inherent in the nature of scientific research. Moreover, he was twenty-two years old and assistant dispenser to a druggist in Paderborn at the time when he succeeded in analysing opium.

Let us examine the background of Sertürner's

success. Chemistry was in its infancy at this time. It was not long since Lavoisier had revolutionised the subject by enunciating the theory of combustion and transforming alchemy into chemistry; opium was arousing much interest and the number of opium eaters was steadily increasing.

Sertürner, though young, undoubtedly possessed remarkable talent, intuition and the gift of observation which is at the roots of all great work, whether its exponent is a poet, a doctor, a chemist or a technician. Most assuredly morphia was no chance discovery. Sertürner had set himself the task of finding the hypnotic principle of the poppy. That it proved to be more than a sleep-bringer, to be the agent that was to relieve suffering humanity from much of its pain was the gift of fortune, was unforeseen and a great blessing.

It is known of Friedrich Wilhelm Sertürner that he was the son of a Viennese military official called Simon Joseph Sardinier, whose family name had been gradually transformed in the Church register into Sertürner. Sardinier settled in the ancient episcopal town of Paderborn, became inspector of public buildings, and died in 1799 at the age of seventy, leaving no fortune. His son Friedrich Wilhelm apprenticed himself to the local apothecary, which was probably not pure chance, as his father had evidently noticed the child's proclivity and had had him well grounded in the natural sciences.

The druggist's dispensary was always a research laboratory, so young Sertürner had free access to crucible and test-tube and was able to devote his spare time to the analysis of opium. He isolated a crystalline

substance from opium which he claimed to be the hypnotic principle of the poppy.

This was in 1803 ; but the discovery of morphia was not published until 1817. In 1803 Sertürner's hands were tied—he was obliged to wait until both he and the discovery had grown older. In those days he was only an apprentice ; but the apprenticeship was soon ended and in 1806 he became assistant to an elderly druggist in Eibeck, near Hanover. An article dealing with caustic alkalis that he wrote at this period was rejected by the *Journal de Chemie* ; the article later proved to be of considerable importance.

On the other hand, he succeeded in obtaining a concession for a new pharmacy in Einbeck ; and thus he had his own laboratory and could do what he pleased. He once more devoted himself to opium, about which he had something new to say ; of this he delivered himself in a paper entitled, " Concerning Morphia, a new salt-forming base, and Meconic Acid, as the chief constituents of Opium." He had continued the work begun in Paderborn, verified his results and on this basis had continued to investigate, analyse and distil, until he had obtained " The chief constituents of Opium." It remained to be seen if they really were the chief constituents.

He decided this question simply ; he and two friends took a certain quantity of this new morphia ; it proved to be a very large dose—three times the normal quantity ; a slight poisoning ensued, but passed off without ill effects. But, more important, the proof that the narcotic component of opium was contained in the morphia was there, for after taking it they indeed rested in the arms of Morpheus. The name was well

chosen, though the pure alkaloid came later to be known by the scientifically more correct designation, Morphine ; but the old name remained the popular one.

The events described above developed very slowly, though it must be admitted that many great discoveries have had to wait longer to achieve recognition. In 1830 Balzac mentioned morphia as one of the subjects of particular interest to the Devil—not thereby referring to morphinism, which did not exist at the time, but to accidents due to overdoses.

Sertürner received adequate recognition fifteen years after the event, in the form of an award of 12,000 francs from the Institut de France " for recognising the alkaloid nature of morphia and thereby opening the way for great medical discoveries." He was also accorded other honours, such as an honorary doctorate at the Universities of Göttingen and Jena, and was presented with diplomas by many of the foremost learned societies. He was probably a happy man. He was able to buy a prosperous pharmacy in Hameln, and take a bride into his home. Freed from cares, he was now in a position to devote himself to his career and to research.

It was he who, during the German epidemic of cholera in 1831, was the first to suggest in a remarkable paper " to the German Fatherland " that " a single, poisonous, self-propagating organism was the cause of cholera." This theory went unheeded at the time and he did not live to see it recognised as the truth and the cholera bacillus discovered.

Though he received plentiful recognition as the discoverer of morphia, he did not live to see the

stupendous rise in importance of the drug. It first came into prominence twelve years after his death, when in 1853, the Frenchman, Pravaz, manufactured a small syringe ending in a hollow needle, which made it possible for drugs such as morphia to be introduced under the skin, thus greatly increasing their potency. The fame of morphia reached its peak when, during the Great War, the sufferings of mankind were multiplied to an extent never before dreamed of—for the millions of wounded morphia was the all-important drug. But the greatness thus thrust upon Sertürner's discovery would probably not have given the inventor much pleasure.

One is constantly hearing it said that the discovery of morphia is the greatest blessing and the greatest curse of mankind. But though the number of those who are physically and mentally destroyed by morphia addiction is great, it is insignificant when considered in relation to the relief brought to sufferers ; just as railway fatalities—or still less suicides who kill themselves under trains—cannot be balanced against the advantages of railway travel.

Certainly the risk of habituation is not the only danger connected with morphia ; it is poisonous in any case, and what has been said of opium applies here in the main. Opium poisoning is in fact morphia poisoning and the symptoms of the acute cases are more or less the same.

As with opium so with morphia, the fatal dose varies ; individual susceptibility differs widely. A case is on record of a three months' child who died from taking less than a two-thousandth of a gram. Adults have been known to die after one-tenth to one-

fifth of a grain, and sometimes much less when ill-health, such as heart disease or pulmonary tuberculosis, has weakened the body's resistance. On the other hand cases are known where people intentionally or while out of their mind have taken or been injected with enormous doses—two or three grams—and have still been saved.

Two grams is usually enough to kill a cow. Animals also have a varying susceptibility to this drug. This depends chiefly on the structure of the nervous system. Dogs, rabbits, mice and rats can be narcotised by morphia ; whereas it excites horses, oxen and cats, and a large dose is required to kill them. Pigeons and chickens can also tolerate large quantities. It is not surprising that animals may also become addicted to morphia. Such experiments can be made on any species from apes to bees. Lewin describes some pigeons that he had made into morphinists and who perched in their cages profoundly depressed until the man with the morphia syringe approached, when his mere appearance roused them from their lethargy.

The course followed by acute morphia poisoning is approximately as follows : profound sleep sets in very quickly ; the face becomes red and the mouth dry ; sleep passes into loss of consciousness ; the pupils contract—often to the size of a pinhead ; breathing becomes slow ; the pulse becomes weak and irregular until it finally ceases.

Fatal morphia poisoning is very common in medical literature ; suicides, accidents and murders involving morphia have constantly recurred during the century since its discovery. It is not surprising that morphia suicides are relatively common. Accidental

substitutions have also occurred from time to time ; in November, 1931, three mental defectives died in the hospital at Neutra from injections that instead of the supposed luminal consisted of an equal and therefore definitely fatal dose of morphia.

Morphia murders are of particular forensic interest. The drug had hardly been discovered when the first crime was committed with it ; in 1823 an English doctor killed a friend by this means. A nurse, Jane Toppan—a human monster—was discovered to have done to death no less than thirty-one of the patients in her charge by means of increasing doses of morphia. There is an almost unbelievable story of a Berlin innkeeper who poisoned an entire wedding party by putting morphia in the guests' coffee—he only wanted to have a joke !

Suicides, accidents and murders brought about by morphia are, however, few in number compared with those who slowly kill themselves with it—the morphinists. It is unfortunate that this drug, which was given to mankind to soften the hour of pain and suffering, should possess the property of producing a " craving " and initiating a habit that leads to destruction. It is by no means confined to persons with a nervous hysterical disposition, though it is to be expected that such people are more susceptible to the temptation and less likely to possess the strength of character when necessary to deny themselves the seductive morphia syringe. It has already been mentioned that animals can also become morphinists.

Among highly-strung people, always on the lookout for new sensations it usually starts with curiosity ; but most cases probably owe their origin to a period

of pain during which the doctor has dulled suffering with morphia, only to open the door to a different malady—morphinism. It is obvious that people easily liable to this form of addiction are those whose profession gives them access to morphia, that is, doctors, dispensers and nurses, and their friends. Statistics on the subject are available, but may not be entirely reliable ; from these it appears that 40 per cent of morphinists are doctors—an astoundingly high figure.

" At first the morphinist enjoys an illusory sensation of increased strength and ability and a heightened appreciation of pleasure. The ego acquires a distorted conception of itself and its relation to the outside world ; but no matter how this state comes into existence, it is real enough to the subject ; and work seems to progress more easily, small rebuffs delivered by crude reality pass unnoticed—or almost so—and this condition of elevation, lasting from six to eight hours, is the result of a single dose of morphia ! " This is Lewin's description of the first phase of morphinism, which is in fact fraught with well-being and contentment.

But soon the original quantity no longer suffices : the organism experiences a violent desire for more and the subject has to choose between agonising deprivation accompanied by terrific self-control—merely to maintain the *status quo* and not even giving him the satisfaction of being a step towards abstinence —and giving in to the craving of his body habituated to morphia and relieving it with larger doses. There are sufferers who daily consume several grams of morphia—as much as one hundred times the dose normally fatal.

The clinical picture of chronic morphia poisoning

has long been known. Ernst Schweninger gave an excellent description in the nineties of the last century. The diagnosis is not based upon a single symptom but a characteristic group of symptoms. No branch of the elaborate human nervous system is immune from damage. Professor Pilez describes the condition as follows :

" Long standing morphinism produces a characteristic bodily exhaustion and general psychic disturbance. In most cases the body weight decreases sensibly, the digestion is violently disturbed. Constipation alternates with diarrhœa. The sufferer tends to feel cold ; he is often afflicted with asthmatic attacks ; the sexual functions are disordered ; sometimes he trembles like an alcoholic. While the morphia remains in the system the pupils are noticeably contracted. The capacity for mental exertion is reduced ; the subject becomes obtuse and mentally flaccid. Noteworthy is an inordinate weakness of will particularly in combating the malady itself. The victim constantly resolves to give it up, but then proceeds to employ the subtlest devices to frustrate any attempt at a cure ; smuggles in the morphia when he has decided to undergo a cure ; procures it by lies and bribery ; and finally, when cunning and deceit have failed, resorts to threats and even acts of violence to procure his release from the institution."

During this stage of morphinism, the poison once so sweet is capable only of rendering tolerable the period immediately following each injection. In the many hours that have to be passed without morphia only disgust with life is felt, a sense of doom, and impotence to avert it. Nothing remains of the heightened vitality

bestowed by the morphia, nothing of the release and the delightful sense of inflated personality.

Once the sufferer admits to himself the destruction of his personality, he becomes incapable of bringing about any improvement in his condition. Thus any effort of will of which he is still capable is used to exploit every possible means of opposing any curtailment of the drug. Descriptions of abstinence phenomena all correspond and show them to be frightful. We know how difficult it is even to give up smoking, and nicotine is in no wise comparable to morphia. It is debatable whether it is better to effect the withdrawal at a single blow or in stages ; most doctors are in favour of the drastic method. This must be undertaken in an institution, since thus means of enforcing complete withdrawal and facilities for dealing with accidents are most readily available ; and accidents are not infrequent during the first periods of morphine starvation, which in any case is a period full of excitement.

Nevertheless Schweninger and most others are in favour of the swift withdrawal. " Though with this method the reactions are more violent, they only occur once ; whereas in the case of the gradual withdrawal, though less stormy, the effects are the more lasting, and the protracted misery, often enduring for several weeks, tends to wear down the patient's strength and will to go through with the cure and at the same time to stultify his trust in the doctor, who, without full authority is unable to carry out the complete cure."

The last injection has been administered a few hours previously and its effects have evaporated. Sensations of extreme discomfort grip the patient. All manner of symptoms attack him. He cannot eat ; he

suffers from palpitations and shortness of breath ; his body is soaked with sweat ; every muscle quivers ; he is filled with deadly fear ; his head aches as if about to burst ; each tooth aches ; every nerve is tormented. He is afraid and frightens those with him. His excitement mounts steadily until he is seized with a fit of delirium, which appears to have no end. He then becomes once more the victim of hallucinations ; hears threatening voices ; sees spirits of the dead ; holds speech with snakes and birds, and feels animals beneath his skin. He itches all over ; throws himself about ; yawns and then becomes restless again, until a fresh fit of delirium masters him, and finally prostrates him with exhaustion, sometimes producing a state of collapse causing serious danger to the heart. A single injection of morphia could put an end to this and relieve the patient of his misery. But it may not be given, if all the suffering is not to have been in vain. The patient and his friends may have to keep up this struggle with the poison for days on end, and sometimes the battle may last for as much as a week.

Once the first week has been survived, the worst is over, and the normal functions begin gradually to assert themselves. Appetite returns ; sleep comes once more, and the patient says he feels better. A few more days of patience and one may hope to have cured a morphinist and to be able to risk sending him back to his family.

There have been many attempts to reduce the pangs of deprivation for those undergoing a cure for morphia addiction. One idea has been to put the patient to sleep during this period. The method has proved satisfactory so long as care is taken, and it is

now customary where possible to keep the patient asleep for the whole of these first few days of abstinence. Hypnosis is sometimes used at the same time, and morphinists are often found to be good subjects. In recent times insulin has also been tried and oddly enough has proved very useful.

Finally, it is worth recalling that at one time an attempt was made to help the addict by substituting cocaine for morphia—the most fateful experiment; one devil was cast out and twelve took its place.

CHAPTER X

A FEW SUBSTANCES RELATED TO MORPHIA

No sooner were other drugs discovered with properties similar to those of morphia than there also arose cases of addiction among those who took them. This is particularly so with codeine and heroin. The physiological and psychological process is the same. To begin with it is the healing drug, prescribed in cases of physical pain or coughing. In many cases, no doubt, the cure is imperfect ; the pain or spasms of coughing soon return and the sufferer is compelled to revert to his powder or tablets—particularly so at night when he is threatened with insomnia from his pain or his torturing cough. He turns to his drug—turns to it even before the pain has come, simply because he fears the moment of its coming. And if fate wills it he quickly habituates himself to codeine or heroin even before he notices it—just as others habituate themselves to morphia—and he becomes its slave.

Codeine is the less important. It is methylated morphine, a derivative of morphium. It is often prescribed mainly on account of its effectiveness in suppressing coughs and because less caution is usually required in the dosage than with morphia. One generally gives three times the dose of morphia. Codeine addicts take large quantities daily, in one case it was as much as three grams—about a hundred times the normal single dose. The symptoms of the addiction are very similar to those of morphinism. Most notice-

able is the extreme restlessness, which can only be allayed by more codeine.

Besides codeine, other morphia preparations have been observed to give rise to addiction. Codeine and similar addictions are rare in comparison with the incidence of morphinism ; but it must be borne in mind that only the most severe cases become known—cases where the victim is so weighed down with his affliction that he cannot carry on and is obliged to resort to the aid of a doctor or an institution.

Heroin, a derivative of morphine (diacetylmorphine hydrochloride) is much more important in this respect, and in many quarters heroin addiction is a close competitor of morphinism. The effects of heroin are perhaps even more lasting than those of morphia ; the damage it does to the system is the same and the cure is, if anything, harder. On account of its popularity in certain circles it plays a considerable part in the great international traffic in delirient drugs and it is often mentioned in the same breath with morphia. Whenever raids are made on illicit drugs it is nearly always possible to impound large quantities of heroin as well as morphia and cocaine. China is one of the biggest importers. The people habituated to opium are generally glad to seize upon other and stronger drugs, and heroin has the advantage over morphia that the pleasurable sensations last longer. But here, as with morphia, a few years of addiction lead inevitably to destruction.

The foregoing by no means completes the list of habit drugs. Ether is occasionally used as a delirient drug, and in some countries it is even quite common.

As an intoxicant it is drunk, mixed with alcohol, or

inhaled. This practice was known long before the medical uses of ether were recognised. Ether intoxication is much the same as that caused by alcohol, but the abuses are of greater importance. Only a small proportion of (alcohol) drinkers become drunkards, whereas ether drinking is always pathological. The practice is particularly widespread in Ireland ; the reason for this is obscure, but it may be that a misguided campaign against alcohol was partly responsible. In Norway and certain parts of Germany ether is a common means of inducing the festive spirit.

Just as the drinking of alcohol is a customary and normally harmless form of enjoyment in our latitudes, so the widespread drinking of coffee and tea need cause us no concern. Coffee and tea addiction is in any case much rarer than dipsomania ; and even when we find people capable of drinking large quantities of coffee during an evening without spoiling their sleep, this is of no particular significance. It is more common to find people who cannot drink coffee (except caffeine-free coffee) or tea in the evening without the risk of losing sleep. Both coffee and tea contain the stimulating substance caffeine, and tea also contains the alkaloid theophylline. That coffee addiction exists—of course far beyond the fondness for the beverage often exhibited—was shown by a case demonstrated by Professor Hermann Schlesinger before the Viennese Medical Society in 1931. The patient, a fifty-year-old mechanic, was brought to hospital suffering from a disorder of the thyroid gland, and it emerged that for some years past he had been accustomed to drinking twenty to twenty-four pints of white coffee daily. His yearly consumption was worked out to be 100 lbs. of

coffee, 1200 quarts of milk and 720 lbs. of sugar. He was at the same time a vigorous opponent of alcohol.

Such cases are rare—and exceedingly unromantic. Romance attaches, however, to hashish.

Baudelaire, who coined the expression "Artificial Paradise," put hashish first among the methods of inducing it, and described it in his writings with a thoroughness worthy of a scientific monograph and at the same time with the rapture of a poet. Many others approached this substance in a similar spirit, all of them drawn by the mystery of the unknown and belief in the romance and wonders of the East which surround it.

Hashish is a term applied to Indian hemp (*Cannabis indica*) and the properties for which it is sought are contained mainly in the flowering tops of the female plant. The drug is not always marketed in the same form. In some areas the flowers are dried and ground up and then mixed with all sorts of sweetmeats—of which there are very many in the East. The juice may also be scraped off the flowers. Another less common method is to make a man walk through the blossoming hemp fields wearing a leather apron to which the valuable resin adheres and from which it can then be collected. Sometimes a little of the leaves or seeds is added to the hashish. The preparation of hashish for smoking is different from its preparation as a sweetmeat. The flowering tops or resin is used for the former and the leaves are usually used for the latter. Both hashish-eating and smoking have many devotees —unlike opium, where the eaters are considerably outnumbered by the smokers. Hashish eaters generally take their drug with black coffee ; the stomach should

be empty and they take care that no meal disturbs their dreams during the next few hours.

Many interesting incidents are to be found in the history of hashish. Most remarkable is the historical fact that in the twelfth century, when the Ishmaelites ruled the Mohammedan lands, hashish was used for political purposes, though it is certain that very few at that time knew of its powers. The drug was principally known to the magicians, the fakirs, servants of powerful masters. Many Ishmaelites were by them made acquainted with the herb and its marvellous properties. While they were under its influence and enjoying drug-induced visions of beautiful women, dancing, music and other sweet dreams, the fakirs would appear and increase the magical atmosphere by their tricks. Then they would suggest to those whose senses were by this time completely numbed that they should carry out sinister orders, such as murders of their master's political enemies.

It is difficult to conceive the strength of this mystical influence—to visualise the situation in which human beings became the slaves of others who had the power to transpose them into a supernatural world of marvels which yet seemed to be tangible realities. So many of these visions were full of beauty and the command to murder which followed did not seem to be specially significant. These hashish eaters were called *Hashishun*; etymologically the name is the forerunner of our word assassin, meaning treacherous killer and having no further connection with hashish.

If we want information regarding this "artificial paradise" we can find plenty of reliable sources. Charles Baudelaire has already been mentioned. He

remarks that the piece of sweetmeat containing the hashish smells peculiar and unpleasant and that the first time one tastes it one is disappointed, particularly as one has to wait longer than one expected for the effect. The first phase of hashish intoxication takes the form of boundless merriment. Life seems gay and laughable ; every gesture, every word, everything one sees suggests such irresistibly comic associations that veritable gusts of laughter are the consequence. One's laughter is genial and contains no mockery ; in fact aggressive symptoms are entirely lacking. This period of overflowing cheerfulness is followed by a moment of sobriety and a vision of the abyss at one's feet. The next phase follows swiftly. Strength goes out of the muscles, the body is seized with numbness and a new soul seems to enter and drive out the old.

This new soul possesses much keener powers of perception than the old. Everything is seen far more clearly, though it may not have quite the correct size and shape. One suddenly possesses an excessively acute sense of hearing and all the other senses become enormously intensified. This increase in the normal faculties is followed by abnormal perceptions. Hallucinations, visions, noises, sensations are conjured up out of nothing or develop from the actual surroundings —things, people, oneself, and the unreal merge into one whole. And everything is pleasant and beautiful and mellow ; one is filled with well-being, full of love for others and inspired by oneself and one's qualities— one's godlikeness.

But next morning ? At first it is not too bad. One is certainly exhausted, indeed very exhausted, but one is satisfied with oneself. Not for long, however. " An

extreme dullness possesses your spirit and envelops all your faculties like mist on a landscape. Now for a few hours to come you are incapable of any work or activity. That is the punishment for your ungodly dissipation and for squandering your nervous energy."

Baudelaire goes yet further and describes the injurious effects of hashish by visualising a world composed entirely of hashish addicts. This would be a truly unreal world and could not last long. Quite a good method of demonstrating how injurious a thing may be and one which might well be applied to other matters. Above all the hashish-addict is a person bereft of will-power. He feels himself elevated—in possession of the most marvellous faculties and at the same time condemned to inability to use any of them. "A soul that sells itself in bits." It is the stock-in-trade of magicians and wizards, but the lonely pleasures that it engenders make the recipient useless for human purposes—superfluous among his own kind, make him, whose thoughts and mind are riveted on a poison, incapable of releasing himself by joining in the work of the world.

Other writers besides Baudelaire have tasted the joys of hashish and described them. Théophile Gautier, for example, who divides hashish intoxication into three phases. At first everything becomes long and stiff, takes on bewildering shapes and grows exceedingly comic. Then visions appear, hearing becomes extraordinarily acute, a great feeling of happiness takes possession of the drug-taker, the soul detaches itself from the body, time has ceased to exist. Then vision becomes doubled, the fancies increase in number, consciousness grows less and less vivid until it is finally lost altogether.

More important perhaps are the reports in medical journals, observations made by doctors on themselves and others. In the year 1926 Joel and Fränkel published a report of their impressions in the *Clinical Journal* (Berlin). They mention a first (negative) phase of oppression and suffocation, of impotence and fear. This is followed by a stage of fantastic visions and the dissolution of personality. These observers, too, stress the extraordinary merriment which the illusions call forth, and the feeling of complete satisfaction, rising sometimes to positive ecstasy.

Schroff—the pharmacologist—describes this as follows: "I was surrounded by an exceedingly pleasant, sparkling light, which penetrated my whole body and made it transparent. I passed through a whole series of imagined conceptions accompanied by an increased feeling of self-importance, an exaggerated idea of my own personality." He was unable to give more than these general impressions of his hashish intoxication after the event, as the next morning his memory retained nothing.

The description given by Professor N. Lange, psychologist at the University of Odessa, of an experiment made on himself is more exact; he had taken about one-third of a gram of the extract. In his case the unpleasant phenomena—the fear, the terrifying visions—were predominant; only at the very beginning did he experience pleasant sensations. It is certain that a sharp distinction must be drawn between the feelings of those who make a single experiment and those who are habitual drug-takers; this is the case with all drugs which play on the imagination.

All who have experience of Indian hemp report

that its powers are excessively destructive, that it ruins the existence of its addicts. It may open a " Paradise," but one on whose doors are inscribed the words from the gates of hell : *Lasciate ogni speranza . . .*"

Hashish is wholly Oriental—exotic. In Central and Western Europe it is known only in theory. Here and there—possibly in some port or some large city—someone may experiment with hashish, but no importance attaches to these isolated cases ; hashish in no way rivals cocaine, morphia or heroin.

On the other hand, it has only recently become known that in certain parts of Russia—in the districts on the shores of the Sea of Caspian, on the banks of the Lower Volga—the consumption of hashish is spreading. Astrachan may be looked upon as the centre of these groups of addicts. The more distressing conditions became, the greater grew the lack of restraint ; the smaller the value set on cultural achievement, the greater the number of those was bound to become who took refuge in a drug which brought at least a pseudo-paradise, even though they had to pay for this enjoyment with ruined health. In these districts hashish is known under the name Anasha ; etymologically it is the same word and chemical analysis has confirmed that there is no difference between the two. Here the drug is always consumed by smoking.

Anasha is either smoked in the form of a cigarette, whereby the drug is mixed with Machorka—coarse tobacco leaves and portions of tobacco stem—or smoked like opium from a needle, or else in special pipes such as are constructed in the East for the purpose.

Anasha trances were known much earlier than the authentic descriptions of them were published, as is

shown by references in Russian literature. Tichonow, for example, in his tale *A Human Life at Stake* tells of the impressions and illusions experienced under the influence of anasha in a den in Samarcand ; his words and conceptions reveal the East in every line. The attention of Russian doctors has, however, only lately been drawn to the problem, which they have now begun to study. The first to report on the matter was probably Anzifferow, who read a paper on it in 1927 at the Russian Neurology Congress. A few years later Professor Skliar and Dr. Iwanow of the Psychiatrical Clinic in Astrachan published a detailed treatment of the subject.

The material studied by these experts consisted of fifty-two cases, mainly chronic consumers of anasha from the prisons and reformatories, sent to the clinic for observation. All the patients describe in detail their sensations when under the influence of the drug. The first symptoms vary. As a rule the delirient condition begins with a feeling of giddiness ; other patients describe noises in the head, a feeling of dryness in the mouth, heaviness of arms and legs or palpitations of the heart. In most cases this phase is followed by the pleasant, joyful stage, the carefree merriment characteristic of the hashish trance, which sometimes increases in intensity till it amounts to an extraordinary sensation of bliss, of being actually in " Paradise." One of the patients said : " If you don't smoke you are disliked—people tease and annoy you. But when you have had a smoke, nothing of the kind can disturb you, you feel as light as swansdown. The sun seems to laugh and you feel overwhelmingly well. . . ."

Here again the spirit of cheerfulness is stressed—

only in seven cases was laughter not mentioned. The laughter is caused by the transformation of ordinary objects into strange, grotesque forms which titillate the patient's nerves. All concerned agree that the laughter cannot be suppressed and is often so violent that the subjects fall to the ground.

Only very few of the patients under observation in the clinic became excitable. Most of them were lazily disinclined to move. " We want to sit still or lie down and dream or laugh." Many disturbances of sensual perception are reported ; one anasha smoker thought he was flying, another that he was sinking into the depths ; in other cases telegraph-poles are seen to fall, or again, people who pass seem to be knocking against each other ; one's whole skin feels like fur, or one has a sensation as if electric currents were passing through the body ; it appears to be unbearably hot or particularly cold. The most frequent symptom, however, is that perception becomes abnormal—e.g. an ordinary match is described as a heavy beam, the stub of a cigarette appears to be such a formidable obstacle that the patient takes a huge stride to enable him to pass over it. This stage is followed by exhaustion which merges into sleep.

Remembering the inclination of all Eastern peoples towards drugs which may be designated as " fantastic," we shall not be surprised to find that hashish is to be found in nearly all Asiatic countries. It is not, however, so popular there as opium. Hashish is consumed in considerable quantities mainly in Upper India, Syria, Persia, in Nepal and Bengal, becoming rarer towards the East, where opium is more favoured.

In Africa, on the other hand, hashish is preferred.

Particularly on the northern coast it is the " poor man's drug." This applies to Morocco, Algiers and Tripolis, where Kif delirium is more usual than alcoholic excesses in our latitudes. Kif smoking is practised down into the Sahara regions. Hemp is planted everywhere like tobacco. For smoking a very characteristic pipe is used—very small, holding very little at a time and with a very long stem.

Some negro tribes too smoke hashish, mostly in thick pipes made of calabash, and it is no rare thing to find hemp-smoking combined with religious rites or other festivities, the fantastic dream-world thus conjured up forming an integral part of the mystical ceremonies. This happens in Central Africa as well as in the East and West and is not likely to cease soon, though European colonists oppose the sale and smoking of hemp with more or less energy.

The harm done by hemp-smoking is obvious, so that repressive measures are entirely justified. Any day on which hashish is consumed is lost time for the smoker, and often the following day as well. The days devoted to dreams part him from reality—and on the intervening days his thoughts are concerned with future indulgence. But even more important than the ethical or economic considerations are those of health. The evil consequences of hashish-smoking follow more slowly than those of other habit-drugs, are different from those of cocaine, opium or morphia, but in numerous cases the consumers are obliged after a few years to consult a psychiatrist and have to be confined in an institution for the mentally deficient or—in the case of primitive races—they relapse into a lethargic state of animal-like apathy. Characteristic of these

patients is their pallid complexion, their unhealthy appearance and uncertain gait.

Ever since hashish has been known it has been recognised that it destroys the individual and can bring whole peoples to a state of degeneracy. Therefore war has been declared on this poison over and over again, a war which seems to be as old as the drug itself. In any case, the struggle can be traced back as far as the fourteenth century. At that time the Arab Sheikh forbade his people to eat hemp and instituted penalties. In vain. The " laughter pills " continued to find new adherents and the knowledge of the drug was passed on from generation to generation.

An order issued by Napoleon's representative in Egypt in the year 1800 is not without interest. The French General decreed as follows : " The use of the beverage manufactured by certain Moslems from hemp and the smoking of hemp seeds is prohibited for the whole of Egypt. Habitual drinkers and smokers of this herb lose their senses and are subject to violent delirium which often leads them into excesses of all kinds. The production of the hashish beverage is forbidden for the whole of Egypt. The doors of those cafés and inns in which it can be procured are to be walled up and their owners sent to prison for three months. Any bales containing hashish which reach the customs authorities are to be confiscated and publicly burnt." Probably this order had the effect of raising the price of the drug, but no other. This state of affairs still obtains in Egypt, although efforts are made to suppress the consumption of hashish.

Thus Indian hemp is to be found all over Asia and Africa and the harm it does is known. It is one more

example of the " Magic of the East " from which the veil of romanticism is gradually being torn. The " artificial Paradise " in which fantastic wealth and limitless imagination combined to unite earthly joys with the dreams and images induced by the drug, has been degraded to the status of an ordinary trance procured by a known narcotic. Negroes resort to it, also unemployed and unemployable, the dregs of humanity and sensation-seekers, the weary and the drunk, all with complete lack of restraint and, one might almost say, with lack of poetic feeling, exchanging for it any true Paradise within their reach and the opiate of work.

Hemp, the poppy, coca—these are the most important of the plants from which mankind has known how to extract the keys to an artificial paradise. But there are others which also belong here and from which effects can be obtained similar to those produced by hashish.

Since America was discovered, a Mexican plant (" Peyotl ") has been known, of which—soon after Cortez had conquered Mexico—Sahagon wrote that it produced terrible or ridiculous visions. Not till comparatively lately, however, have details of this strange plant emerged. In the eighties of last century scientific research lifted the veil and the plant was endowed with the name Anthalonium Lewini. It contains alkaloids, one of which—Mescaline—produces illusions. It is a species of cactus, only to be found on the sparsely vegetated plateaux of northern Mexico ; it is greatly prized by the Indian tribes who inhabit them, and by traders who realise its commercial value.

This Peyotl of ancient Mexican fame is still

sought, not only by the Indians, but also by many Europeans who succumb to the temptations of tropical poisons—its devotees know it by many names. A stranger visiting these districts may at times see a man lying in some side alley in a drunken stupor, entirely unconscious. Someone better informed will probably explain to him that what he sees is a consequence of " mescaline," a poison which produces hallucinations. These are entirely different in character from those produced by hashish. The subject is captivated by them, but is nevertheless fully conscious and able clearly to describe what he sees, what conceptions have taken possession of him. These are mostly strange fantasies, colours and shapes, grotesque, impossible ; the visions are usually accompanied by a cheerfulness of spirit, a feeling of enhanced self-confidence and increased energy ; this was probably the reason why Peyotl used to be the warriors' beverage, taken before they went into battle. The stage of severe poisoning, of reduced consciousness, is not generally reached till a very large quantity has been indulged in.

It is possible that similar poisons are contained in other varieties of the cactus—there are a great many plants in existence which have not been analysed for their pharmacological properties. It is a strange fact that the fly-agaric, the toadstool *agaricus muscarius*, also has the quality of producing a trance-like condition. This too, has long been known. It is the drug favoured by the inhabitants of northern Siberia and was probably known long before the Russian State caused vodka to be sold there. The dried fungus or an extract from it produces the desired effect. The trance affords strange visions which do not, however, disturb the

feeling of happiness engendered by the drug, though they may make the subject restless.

Finally, the " Loco "-plants should be mentioned, a species of broom to be found on the American steppes. Horses, cattle, sheep sometimes nibble it, and then these animals resemble human hashish-eaters or morphinists. They are the victims of hallucinations and illusions, as may easily be deduced from their motiveless movements—they jump over leaves as if they represented formidable obstacles, they fall down suddenly, obviously from sheer fright, and finally they deteriorate physically with horror in their eyes—like humans !

Some scientific discoveries can be prophesied. Thus Professor Louis Lewin, the best toxicologist in Germany, said many years ago that every country has its own delirient drug, its own species of trance. When, in order to demonstrate this, he drew a map of America, showing the scope of the various delirients, there was a blank in South America, representing a country " undiscovered " in this sense. This blank covers a large portion of northern South America, parts of Brazil, Venezuela and Peru. For several decades Lewin studied every traveller's account of these districts without finding the material with which to fill in his blank space. Was it possible that there really was a drugless tract surrounded by poison territory ?

It seemed most unlikely, and in the end Lewin was proved right. Karsten of Helsingfors and Koch-Grünberg published accounts of journeys in the Amazon country which included tales of a strange drink taken by the native Indians, one of which induced a kind of delirient trance. Kaapi was its name and it was

prepared by boiling a particular plant. About a quart is drunk, then the effects become apparent—a narcotic condition with visions of lakes and cities, of animals and trees ; with bright flickering lights before one's eyes ; with sensations both pleasant and alarming. Though the reports do not clearly show this, it must be assumed that the pleasant hallucinations are predominant and that the kaapi trance in the main releases agreeable feelings.

This is plainer in a communication which we owe to the British traveller, Gordon Maccreagh. His report was published in 1928. He had travelled for two years in the Amazon territory, had had manifold experiences on the Rio Beni and the Rio Negre and had heard of mystic ceremonies at which the Indians of the district drank kaapi, the drug that makes one brave. He was present at one such ceremony, a kind of exorcism of devils, in which blows with whips played the painful and principal part. The Indians had to endure this maltreatment in silence, so it was obviously desirable for them to take a drink first, one which would make them brave and presumably less sensitive to pain. About an hour after the festivities began kaapi was passed round in little carved bowls ; it was a watery, almost colourless, insipid liquid with a slightly bitter taste.

Gordon Maccreagh expressly states that the effect of the kaapi is quite unlike alcoholic intoxication. He experienced increased animation and energy, a carefree sense of daring. He says nothing of hallucinations, though it is of course possible that some items in the ceremonies he describes—the exorcism of the devils, the whippings executed by the Indians on each other, the

spectre-like appearance of the medicine-men, the clash of musical instruments, the dances performed by the Indians—were not actual happenings, but the products of an imagination stimulated by kaapi. This, however, is a mere supposition.

More details were not forthcoming till the plant was discovered from which the Indians in northern South America manufacture kaapi, its actuating principle ascertained and experiments had been made on men and animals. Then it was found that this delirient also possessed therapeutic properties. If kaapi had been nothing but an exotic delirient poison, it would not have aroused much interest. But the experiments revealed curative properties—though not to the same degree as in opium or cocaine. Their helpful attributes were not discovered, however, till they had been in use as delirient drugs for thousands of years, so it is possible that kaapi may at some future date prove even more useful than it is known to be at present.

Gordon Maccreagh thinks that kaapi is prepared from the leaves of a vine. In actual fact the plant from which it originates is a liana—*Banisteria kaapi*—and Merck succeeded in bringing a specimen to Europe for experimental purposes. The actuating substance—called banisterine—is an alkaloid; by means of alcoholic extracts and vaporisation it is possible to obtain one gram of banisterine from about half a pound of the dried plant. The alkaloid appears in the form of colourless needles. If an animal is injected with banisterine, its reflexes are stimulated, it grows restless, is seized with convulsions, then with paralysis, followed by death. A dog was injected with

one-tenth of a gram and after a few minutes it was observed to be greatly excited, both physically and mentally. No one could approach it, as it attempted to bite everybody ; it ran along the walls of its cage as if it were exercising in a riding-school, then lost its balance, fell over and attempted to get up again. After about three hours the symptoms of poisoning disappeared.

Professor Lewin conceived the idea of trying banisterine on sufferers from paralysis due to brain maladies, as the drug stimulates the muscles. The first patient to receive an injection of banisterine was a woman who was completely paralysed on one side in consequence of hæmorrhage in the brain. The injection did her good and helped her in her attempts to walk, so the experiments were continued on a larger scale with satisfactory results. Banisterine seems likely to play a part in the treatment of certain kinds of paralysis, notably those following inflammations in the brain. Possibly this means that once again pharmacology has been enriched and a remedy extracted from a delirient poison known only as such in its distant land of origin ; moreover in this case it would mean a remedy for pathological conditions which have hitherto been looked upon as practically incurable.

CHAPTER XI

CHLOROFORM

One autumn, more than a hundred years ago, a great man succeeded in presenting to a world not free from cares and oppression a thing most fittingly and truly described by the trite designation—a blessing to mankind. This was chloroform.

True, when in 1831 Justus v. Liebig made the discovery, it was no more than a chemical event—not even a sensational one—brought about by the greatest chemist of his time ; neither he nor his contemporaries knew what a gift had been made to medicine, to suffering humanity. Surgery was at that time dependent on the—at times almost fabulous—technique and swiftness of the operating surgeon and on the help of certain drugs known to have a benumbing effect. Mixtures, consisting mainly of opium, hashish, belladonna or alcohol aided the efforts of the doctors to reduce the torment of an operation and render the patient semi-conscious.

More important, however, were the surgeon's technique and the extreme rapidity with which he worked, the necessity for which disappeared when narcotics were introduced and which impresses present-day surgeons as savouring of the miraculous. Langenbeck, the great surgeon, who died in 1887, was a wonderful exponent of this technique from the very beginning of his surgical career, and was particularly proud of his amputations, for which he needed less than a minute. The anecdote of an American doctor

who had come to Europe especially to witness Langenbeck's rapid amputation of a leg, is well known. He did not see it, however. Langenbeck's account of the episode is as follows: "My colleague, who was a passionate snuff-taker, stood by, and just as I had taken my knife to make a lightning cut, he had turned aside to take a pinch and, turning his back on me, pulled out his handkerchief; when he turned back to watch, the leg was off and he had sneezed away his journey from America!"

Chloroform, that infant prodigy of chemistry, was the subject of dispute among several putative fathers, before Liebig's priority was conclusively shown. Liebig was at that time occupied with pure chemistry, he was investigating the organic acids and the influence of chlorine on alcohol. In the course of his experiments with chloride of lime on organic substances, particularly on alcohol, he obtained a few cubic centimetres of a liquid which seemed as if it would repay closer examination. It was a clear liquid with a sweetish smell, which evaporated quickly and was therefore regarded as annoying, unpleasant, and even injurious to health. He called it carbon chloride.

Almost at the same time Eugen Soubeiran, a Paris druggist, discovered the new substance. He had applied an almost identical method. Chemistry was then at the beginning of its greatest era, which makes it easy to understand why identical processes were being carried out in the most variously situated laboratories by scientists hoping to obtain interesting results. Both Liebig and Soubeiran realised that they had found a new substance, though at first they were ignorant of its chemical formula and of the potential

uses of this strong-smelling liquid. A little while later —in 1834—the Parisian chemist, Jean Baptiste Dumas, discovered the formula and christened the substance chloroform ; a few years later still J. H. Simpson discovered a use for it and undertook—in November, 1847—the first operation under chloroform.

Simpson's was not the whole credit, however. Two years earlier the idea of general anæsthetisation had been used by a dentist—Morton of Boston—who had had the extraordinary courage to anæsthetise a patient in order to extract a tooth. Morton's friend, Jackson, had told him that the inhalation of ether vapours reduced one to a condition in which one is unconscious and feels nothing. A casual communication, a short conversation between two friends—that was all. It may even have been some time before they decided to test the virtue of the discovery and extract someone's tooth after having caused him to inhale ether. . . .

That needed courage certainly ; but J. H. Simpson in Edinburgh needed no less courage when he ventured for the first time to apply a general chloroform narcosis. As soon as he learnt of the American dentist's successful attempt he had made use of ether in his practice, particularly in obstetrical operations. But he was not satisfied with the results ; ether acted too slowly, and, moreover, the narcosis was preceded by too long a period of great excitation and restlessness. Then he experimented with other media which he believed to be more suitable than ether for narcotic purposes and thus he arrived at chloroform.

The historical date is well known ; on 4th November, 1847, in the evening, he discovered the narcotic

effect of chloroform vapour. He and his assistants inhaled a little chloroform and carried on an ordinary conversation while so doing—until he woke up. He was lying on the floor, one of his assistants beside him, and his whole family was assembled around him, filled with alarm and ignorant how to help. Only Simpson himself quickly realised the import of what had happened : he had found a substance which—better than ether—could swiftly send a patient into such a deep sleep that every sensation, including pain, would be swallowed up in it.

What then followed was the fateful battle waged by a discoverer on behalf of his discovery, a violent battle against prejudice and objections, against doctors and clerics, but a battle that Simpson won hands down. Chloroform became the principal means for inducing a general narcosis and will remain so till a better is found. With its discovery is joined the great improvement in surgery in the nineteenth century, an improvement of greater dimensions than has ever taken place in any branch of medicine. Everything to which surgery has attained it owes to two discoveries—the aseptic method and narcosis. And for decades when narcosis was mentioned this always meant chloroform. Dieffenbach could truly exclaim : " The marvellous dream that pain has been taken from us has become reality ! "

A heavy liquid, clear as water with a sweetish etheric smell, easily vaporised and rapidly disintegrated by light—that is chloroform, its chemical formula is $CHCl_3$ and it is a combination of carbon, hydrogen and chlorine. A dark bottle containing the narcotic and furnished with a pipette, a kind of wire muzzle

covered with gauze placed over the patient's nose and mouth, that is all that the anæsthetist needs. "Breathe deeply and count, please—one, two . . ." The patient repeats: "One, two, three . . ." till he confuses the order of the figures and, under the influence of the chloroform passes into a deep sleep in which he feels nothing, is aware of nothing and dreams nothing. Sometimes, but not always, the sleep is preceded by a short stage in which the patient is excited. The anæsthetist's pipette continues moistening the mask over the patient's face drop by drop with chloroform, very slowly, neither too much nor too little. Even this narrow field of medicine has its artists, doctors who are famous as anæsthetists. Occasionally the operating surgeon asks: "Everything all right?" and the anæsthetist answers: "Quite, pulse and respiration good." On the one hand breathing and pulse must be carefully checked, on the other the anæsthetist must not allow the patient to awake before the operation is concluded. All anæsthetists are aware of their great responsibility—deaths under narcosis are by no means unknown.

On 4th November, 1847, Simpson had used chloroform for the first time to produce narcosis, and at one o'clock on 28th January, 1848, the first death under chloroform narcosis occurred. The first victim in a great cause. This was a fifteen-year-old girl named Hannah Greener, living in a village near Newcastle-on-Tyne. The operation was a trifle, a mere question of an ingrowing nail. She had only inhaled the chloroform for about half a minute—i.e. a very small quantity—when she died. The autopsy revealed nothing particular. The next victim was a lad

of nineteen in Aberdeen ; on 8th February, 1848, he had attempted to anæsthetise himself " a little " with chloroform, in order to experience the sensation. A few days later a woman of thirty-five named Martha Simmens died under chloroform which had been given her because the roots of some of her teeth were to be extracted ; she had inhaled the chloroform for—at the most—a minute and a half. Those were the first cases and they were followed by many others. They were all conscientiously noted and published. Both young and old thus died under chloroform, people who were suffering from serious diseases and others whose maladies were trifling.

The surgical departments of hospitals in all countries which made use of the process soon had fatal cases to report, including operations by famous surgeons such as Esmarch and Langenbeck (1849). At first, perhaps, it may have had something to do with the inexperience of the anæsthetists, but fatal cases also occurred much later when chloroform was being used daily for narcosis. True, the percentage was not very high. Legouest, for instance, reports that in the Oriental War there had only been two cases of deaths under chloroform out of 18,000 operations performed with its help. It is, however, very difficult to judge how high the total percentage of " chloroform deaths " really was in the years in which chloroform was practically the only substance used for general narcosis. It is only natural that the exactitude of the published reports on such deaths should have declined later—a death under narcosis is a most depressing event in any clinic. In the nineties of last century, statistics were taken in all German surgical departments embracing

200,000 cases in which chloroform had been used; according to these there had been one death to every 2300 cases. Narcosis with pure chloroform came to be used less and less; Billroth's mixture, for example, was preferred. This consisted of chloroform mixed with ether and alcohol, was not so volatile as pure chloroform and was therefore not inhaled in such large quantities by the patient.

Of course very many—in fact, nearly all—cases of death under narcosis were carefully studied on the dissecting-table. A number of these cases were cleared up—cardiac affections of all kinds made such deaths comprehensible. Then it was observed that chloroform spelled a particular danger to alcohol addicts. It had, of course, always been recognised that the technique of anæsthetisation played an important part. It may happen that the tongue of the unconscious patient falls back in such a position that the entrance to the larynx is covered, so that the patient is in danger of asphyxiation. Every anæsthetist has an instrument at hand with which he can draw out the patient's tongue.

But, apart from these fatal cases for which a reasonable cause can be found, there is a considerable number which admit of no rational explanation—mysterious deaths of apparently perfectly healthy subjects who had been chloroformed with due care and observance of all the rules, sometimes after inhaling a very small quantity only. Here again we must refer to the mysterious super-sensibility shown by some people towards particular poisons, a sensibility that can turn a trifling incision into a tragedy.

These events explain why modern surgery has to a great extent relinquished chloroform. Ether has been

adopted—or rather re-adopted—in its place, and the technique of narcosis has been changed, for example in respect of preparing the patient by means of soporifics and injections. That is not to say that chloroform has lost its value and that nothing remains of it but historical interest. It is still employed a great deal and must still be reckoned among the benefactions of mankind, but its use has to be subjected to restrictions.

Chloroform sometimes comes within the range of the police-surgeon or the specialist in forensic medicine. There have been cases of suicide with chloroform. Worthy of mention is the case of a doctor who constructed an ingenious apparatus for anæsthetising himself to death. Murders by means of chloroform are not unknown, but more frequent are the cases in which chloroform is used for other crimes, such as sexual offences or robberies. A case of this kind occurs occasionally in railway carriages, for example. Most of the reports of chloroforming by violence must, it is true, be accepted with reserve—hysteria and imagination are responsible for some of them, but sometimes they are true. At the end of September, 1931, an authentic case occurred in Vienna where a girl of fifteen, a student at a commercial college, was enticed by a tailor into his flat, there rendered unconscious with chloroform and violated. The details of this case might have been the plot of a lurid " shocker " of the worst type.

Then there are the people who take to chloroform in the way that others take to morphia or cocaine. It is impossible to judge of the numbers of these chloroform addicts. They include former morphia addicts and people driven by pain to seek narcotics. They inhale the vapour at intervals ; sometimes they con-

sume as much as five hundred grams of chloroform daily, which is a very large quantity when one remembers that for an ordinary narcosis of an hour's duration only thirty grams are needed. The fate of these addicts is similar to that of morphia takers—decay of body and mind.

But Liebig did not dream of any of these effects when at the end of the year 1931 he added alcohol to calcium chloride and obtained a liquid scented rather like apples, which received the name of chloroform.

CHAPTER XII

ARSENIC

The proportion of female murderers to male is about one in five, but when it is a question of poisoning the numbers are approximately equal. The favourite medium of female poisoners is still, as it has always been—arsenic. From the famous cases of poisoning which form part of the world's history down to the obscure poisoners who create a sensation in, for example, some little village in Hungary, arsenic has almost always been the means to a terrible end—so much so, indeed, that in comparison with arsenic other poisons are very nearly negligible as instruments of murder. The facts that arsenic has been used in medicine from the earliest times, that it was employed for centuries as a rat poison to the exclusion of any other and that it was everywhere easy to obtain, explain the preference given to this substance, known to inorganic chemistry as a semi-metal, though there is very little about it that is metallic.

Arsenic occurs very frequently in Nature : arsenical pyrites, arsenical iron, cobaltine, orpiment are some of the minerals that contain arsenic. What is described as arsenical poisoning, is usually due to arsenious acid and other compounds of arsenic, both organic and inorganic. What is generally sold as "arsenic" is arsenious acid in the form of a white crystalline powder.

Discorides, a great physician who lived about 100 B.C., said of arsenic that it was the greatest of all remedies, but also the greatest of all poisons. It is

actually one of the oldest drugs known and is still utilised a great deal, though other preparations of arsenic seek to rival it. Taken internally or injected, it certainly stimulates metabolism; an arsenic cure often improves the patient's appearance, appetite, weight, exercises a beneficial influence on the red blood corpuscles and as it is absolutely harmless when taken in the right doses, there is no reason why therapeutic medicine should reject this valuable remedy. Sometimes external applications of arsenic are made—arsenious ointments are frequently employed, for example in some of the newer cancer treatments, though here the fact of its use is not always disclosed, as secrecy is sometimes thought to enhance the effect of a remedy. By far the most important organic preparation of arsenic is salvarsan, discovered by Paul Ehrlich and pre-eminent, as is well known, in the treatment of syphilis. But Ehrlich's great dream—his hope that he had found in salvarsan a substance which would rid organisms at one blow of injurious bacteria, his wonderful conception of a *therapia magna sterilans*, was not realised. All the combinations of arsenic already mentioned and many others can cause harm—voluntarily or involuntarily—and the cases known to criminology would fill a whole library of books—to say nothing of those which have remained hidden.

The symptoms of arsenic poisoning must be divided into two groups, one under the heading of acute poisoning, the other of chronic poisoning. The symptoms apparent to patient or doctor are not, taken singly, definitely indicative of arsenic poisoning, but the general clinical condition usually points to the right diagnosis, at least in severe cases. Doubts can

be resolved by chemical analysis. If a person has taken a sufficiently large dose of arsenic at one sitting, then the signs of poisoning are very violent. They are identical with those of severe inflammation of the stomach and intestines, approximately the same as in cases of cholera with the addition of terrible pain, cramps, unconsciousness followed by death after some hours or days. The symptoms reminiscent of cholera are seldom absent, but when they are not present, the dominant signs are disturbances of the nervous system : restlessness, terror, fainting-fits, cramps and paralysis.

The phenomena attendant on the chronic form of arsenic poisoning are much less easy to diagnose, though in many cases clinical observation shows that the patient is at least seriously ill. Appetite begins to fail, the patient looks sallow, his stomach is disordered, he suffers from cramps, great fatigue—his hair falls out, he often has a kind of eczema on his skin ; in short his serious condition is shown by many signs, but it is often very difficult for the doctor to find their cause. He is confronted with a mystery and, even if he suspects arsenic, it is still difficult to find its source.

Apart from planned murders, arsenic poisoning may occur in circumstances where it is practically impossible to detect the cause. Recently, for example, arsenic has been used much more frequently than in former times in the campaign against noxious insects and pests ; aeroplanes are used for the purpose, which strew the poison over woods, in order to preserve them from destruction by beetles. In Alsace the vines are treated with arsenic for the same reason, in California sometimes the apple trees, and in other places corn may be sprinkled with it. These are all potential

sources of arsenic poisoning which, when it occurs, appears to be so mysterious in its origin that only a lucky chance can solve the puzzle.

Arsenic can sometimes penetrate into the organism through the skin. This often happens to artisans whose work is connected with preparations containing arsenic. In such cases the origin is not far to seek, but it occasionally happens that dresses or stockings have been dyed in colours containing arsenic and that they then cause poisoning of which it is exceedingly unlikely that the cause will be found quickly—or at all. The much-discussed subject of poisonous wall-papers comes into this category.

There is no doubt at all that formerly wall-papers and textile wall-coverings often contained arsenic, and it is just as certain that a great many cases of arsenical poisoning arose from this cause, some identified and a great many more which were not. And even in our day the possibility cannot be excluded in all cases of obscure disease. Modern dye industry naturally takes this factor into consideration—the rules set up by social hygiene have resulted in the manufacture of wall-papers and colours free from poison, and painters and decorators are no longer in danger from this cause. Unhappily there are exceptions when, for example, someone uses Paris green to attain a beautiful clear colour. It is possible to combat negligence in the gross, but isolated cases persist.

Arsenic has played an extraordinarily large part in crimes of all ages. The ancients were already aware that arsenic is a poison. Aristotle mentions it, i.e. in the fourth century B.C. But it did not become the "classical" poison till the Middle Ages and ensuing

period, when one might almost say it was the fashion in the East, in Italy and many other countries thus to rid oneself of an inconvenient husband, a discarded but persistent lady, a dangerous rival—for the throne, in the office or at home ; it was then that those murders were committed which have been handed down to us as historical. This was the time when the " silken cord " had not begun to function in Constantinople, when in Italy the rebirth of science and art brought death to so many people, when the famous cabals ruled at the smaller courts, when in France eroticism knew no limits. One of the most notorious female poisoners of past ages (her notoriety is only exceeded by that of Lucrezia Borgia, whose evil deeds, however, were not recorded officially) was the Marquise de Brinvilliers, of whose life much has been written.

Her maiden name was Marie Marguerite d'Aubray ; when she was twenty-one—in the year 1651—she married the Marquis de Brinvilliers. Soon after, she made the acquaintance of a young officer by the name of Sainte Croix and fell in love with him ; her parents, however, insisted on the young man's being sent to prison for a year—a somewhat drastic method of breaking off relations between him and their daughter. Wulffen, an eminent expert in the domain of criminal pathology, believes that this form of compulsory separation awakened all the evil instincts in the woman. It is probable that the meeting of the two complementary natures was the cause of all the terrible events that ensued : the woman, unrestrained and passionate, the man with criminal instincts who learnt in prison the methods which he was later to employ. When he left the Bastille after his year of incarceration these two

people began their career of crime. The " succession powder " used by the Marquise was put into operation and she poisoned one after another her father, her two brothers, and her husband, after having tested the efficacy of her powder on several uninterested persons.

The two criminals were discovered through a most extraordinary circumstance. Sainte Croix died of arsenic poisoning. The accident was his own fault, he had been experimenting with the poison. (The chemist, A. Gehlen, died in a similar way—through an accident while experimenting with arseniuretted hydrogen.) Among his papers a document was found entitled " My Confession " ; like many other criminals he had kept an exact record of his crimes. When the Marquise heard that her evil deeds had been discovered she fled into a convent at Liége. There she was visited by a man who pretended to be in love with her and persuaded her to meet him outside the convent. He was, however, a detective, sent by the Courts to induce her to leave her asylum. He handed her over to justice. She was executed in 1676 and her corpse burnt. Before she died she received absolution. She too, left a confession in the form of notes, the accuracy of which, however, she denied during her trial. She became and remained a much-discussed personality in criminology, in literature, and was even used as a subject in the plastic arts.

Anna Zwanziger, another notorious woman poisoner, wrote her autobiography, and Anselm von Feuerbach has also given us the story of her life. She used for her murders a solution of fly-powder (metallic arsenic) and rat poison (arsenious acid). She lived for a time in Vienna, went into service with a bailiff named

Glaser in Piegnitz and poisoned his wife, because she hoped that the widower would marry her, though she was fifty years old and repulsively ugly. After that she took service with another bailiff who shortly afterwards died suddenly of poisoning. Years later at her trial she asserted that she had not meant to kill him, but to annoy his two manservants by her poisoned beer. After this man's death she served in the house of a treasury official and a few days later she poisoned his wife. And for the next few years deaths of this kind continued, many of them conclusively proved to have been the work of this monstrous woman. One family had given her notice, and in that case she put poison in the salt-cellar before leaving. She was executed by the sword in July, 1811.

Another murderess who used arsenic—in her case it was ratsbane—was a woman named Gottfried, a person permeated by evil, good-looking and very vain. For her execution she put on two pairs of stockings to enhance the fine shape of her legs.

The case of the man Hopf is well known in the appropriate literature. He had tried all kinds of employment both in Europe and in Africa—druggist, artiste, fencer, dog-fancier. He was certainly talented, had both sadistic and masochistic tendencies and was a great criminal. He was accused of many murders—of his father, his mother, an illegitimate child, his first wife, a legitimate child ; and of the attempted murders of his second and his third wife. And though not all these could be proved to have been committed by him, the proofs were sufficient to cause him to be condemned to death in January, 1914. He had used arsenic, though he seems to have had a large store of other

poisons. He administered the poison to his victims in their food and drink ; when his wives fell ill, he was most attentive to them and gave them champagne, which was also poisoned with arsenic. His motive was the insurance money. The mysterious illnesses and repeated deaths were commented on by the neighbours. A servant, who had seen him secretly put something in the tea he gave his second wife to drink while she was ill, wrote to the wife's parents, warning them against Hopf. The result of this was a prosecution for slander ; the servant was sentenced, as were several other people who had identified themselves with her suspicions. Wulffen describes Hopf's despair after the death of the child he had himself killed. " One witness said that he (Hopf) was only acting, another that his behaviour had been a riddle in psychology. Perhaps it was that curious mixture of acted and genuine pain sometimes seen in the case of great criminals. These obscure phenomena are not uncommon in criminals and are the visible signs of the battle raging between the remnant of good and the overwhelming evil in their souls."

An interesting case of murder by poison happened in the year 1869. A peasant by the name of Vogelsinger had been found murdered in a village in Lower Austria. A mill-owner—Solterer—was suspected of the deed. The two men had entertained secret and intimate relations with one another, and Vogelsinger had once been heard to say : " If Solterer wants me to give him rat poison, he knows where to find me." The police also learnt that a little while before, both a maid-servant of Solterer's and his brother had died in suspicious circumstances. Their bodies were exhumed

and autopsies were performed, which revealed that they had both been poisoned by arsenic. Solterer had been intimate with the girl, and was said to have been annoyed with his brother because the latter owed him 1500 gulden. The police assumed that Solterer had murdered Vogelsinger in order to rid himself of the man who had supplied him (Solterer) with the arsenic. His counsel, Dr. Neuda, succeeded, however, in getting him acquitted.

Cases of murder by arsenic poisoning have been very frequent even in recent years—the poison does not seem to have become less popular with murderers. In the year 1926 the Berne doctor—Riedel—and his mistress were sentenced to twenty years' imprisonment. The Court was of opinion that they had poisoned the doctor's wife, using arsenic. Another doctor—Laget—was accused before a jury in Montpelier in the summer of 1931, of having poisoned his first and his second wife by the administration of arsenic. The case rested on circumstantial evidence only, but the doctor was condemned to death.

At about the same time a Court in Krems was concerned with the trial of a woman owner of a farm, aged sixty, accused of murdering her son-in-law (of whom she had good reason to disapprove) by putting arsenic in his milk. The woman, whose name was Therese Weissgram, was sentenced to eight years' imprisonment.

The trial of the women poisoners in Theisswinkel caused a great sensation. In the year 1930—in Szolnok—a picture of rural domestic life was unfolded which left nothing to be desired in the way of drama. The village in which Maria Kardos lived was a centre of

poisoners ; all the women possessed arsenic, and anyone who stood in their way was ruthlessly exterminated—it was no extraordinary occurrence. Maria Kardos had poisoned her son by her first marriage and her second husband by means of arsenic. The motive for the misdeeds of this ageing woman was a young lover ; she had once been the village beauty and one might designate her as a village courtesan in a large way. When she had set the glass of poisoned wine before her son, she asked him to sing her her favourite song. He sang it and then emptied the glass. . . . She was executed. Shortly before she paid the extreme penalty she received a visit from the latest of her lovers.

It has often been demonstrated that traces of arsenic can still be found in corpses after the lapse of years. It was shown, for example, in connection with a trial for murder by poisoning in Linz in the year 1932. Here a peasant aged seventy-three had died five years earlier after a short illness. Possibly the crime would never have been discovered if the murderess's own daughter had not betrayed her mother. It was then proved that Krammer's wife had given the old peasant arsenic with the help of her son-in-law—whose mistress she was—and of her daughter. So much arsenic was found in the body that the forensic chemists assumed that the old man had taken perhaps a thimbleful of the poison, that is, an enormous quantity, sufficient to cause the death of a great number of people.

CHAPTER XIII

ATROPA BELLADONNA

Atropa Belladonna—It sounds romantic through the connection of the name with beautiful women. The connection is not due to its attribute as one of the most dangerous of poisonous plants, but because of its employment as an aid to beauty. From this use developed its application by oculists. The juices of this plant enlarge the pupils of the eye, and in olden days the ladies, who knew even more about cosmetic art than the most worldly of its present-day devotees, were wont by its aid to endow themselves with shining eyes of unfathomable depth in which men sought their happiness. Atropa Belladonna. The name is, of course, made up of " beautiful lady " and Atropa=Atropos, one of the three Parcæ whose task it was to cut off the life-threads of human beings. It cannot be said that the combination of these two designations has always been inappropriate.

The German name *Tollkirsche* means " crazy cherry," the term presumably having been chosen, because the cherry-like berries have the effect of producing fantastic visions, delirium and hallucinations, such as affect persons of unsound mind. The English name nightshade (the corresponding term denotes in German the family to which the plant belongs) is probably an allusion to the fact that the plant flourishes in the shade of dark woods and possibly to its ability sometimes to cast the shades of night over a person for all eternity.

A botanical description of deadly nightshade would be a shrub which can grow up to about two yards in height and has large, mainly oval leaves running to a point. Characteristic of this plant are the five-petalled blossoms of a washy purple colour and still more the glistening berries of a dark violet colour. They look like little cherries and are so attractive to children that they have caused many a tragedy. Doctors have been known to start a campaign for the complete annihilation of these plants in the surrounding woods of their own neighbourhoods for this reason. The plant needs porous soil ; wet soil is harmful to it, but in a rich vegetable mould it may live for ten years or even longer. It is found in mountain forests, often for instance in the chalky hills of Thuringia, very frequently in beech woods, and, in spite of its name, sunshine is good for it. It needs a certain amount of warmth and can therefore live even in the climates of Africa and Asia. It is specially cultivated on account of its uses in pharmacy.

Some botanists are of the opinion that deadly nightshade flourishes particularly well in the shade of copper beeches—there are many examples of such affinities in the plant world. On the other hand it is easily demonstrable that nightshade grows in places where there are no beeches at all. Probably the seeds are carried by birds, particularly by blackbirds, which accounts for the presence of nightshade in some gardens. Professor Mayerhofer mentions the case of a child who was poisoned by eating the berries of a plant growing on a roof garden in Vienna.

The poisonous content of deadly nightshade—mainly atropine—is to be found in the leaves and berries. Although the percentage of poisonous matter

is really very small—one half per cent in the leaves and even less in the berries—cases of poisoning are frequent because belladonna is a very strong poison. Chemists keep pure atropine as well as an extract of the leaves. Medicine has many uses for this. The very smallest quantity—one two-thousandth of a gram—suffices to restrict glandular activity. Principally it is used to reduce the night sweats of tuberculous patients, which is a most tormenting affliction ; but it is also employed in very small doses when the salivary or stomach glands are over-active. Dryness of the skin and in the mouth and throat are accordingly the very first symptoms of atropine poisoning.

To attain a different medical result—namely, the paralysis of or cramp reduction in involuntary muscles, double or three times the quantity of atropine is needed. Anyone can observe this effect on looking at an eye into which a few drops of atropine have been trickled, as is often necessary in ophthalmology. The pupil becomes enlarged, the brown, blue or grey iris which gives the eye its colour is seen as a narrow ring which serves only to enhance the deep black of the inner mysterious-seeming pool. Physiologically speaking, this is a paralysis of the muscle of the eye which governs the iris and causes it to function like the diaphragm of a camera.

Other branches of medicine besides ophthalmology make use of this effect of atropine on the involuntary muscles, for example on those of the intestines or bladder ; convulsive contractions of these organs are released by atropine and the drug is also one of the most reliable remedies for colics. It is also a good antidote in cases of morphine poisoning.

Alone these various possible uses in medicine show that intentional or unintentional poisoning may easily occur. Careful doctors, therefore, administer atropine themselves, especially where it is given in concentrated form or used as in ophthalmology. The symptoms of acute poisoning by belladonna—or its principal poison atropine—are at first dryness in the mouth, enlargement of the pupils, double vision, giddiness ; the skin becomes red and spotty, the patient has a feeling of fear, is excited, suffers from hallucinations, delirium as in alcoholic intoxication—finally paralysis and unconsciousness supervene. Some of these symptoms are reminiscent of those in severe cases of food poisoning. Medical literature reports many cases with lethal ending. There have even been cases of breast-fed infants being poisoned with atropine, because the mother had been dosed with it and it had been absorbed into the milk. The nightshade berries themselves are so deadly that a very few suffice to entail the worst consequences. There is one case of special interest in which the patient was poisoned because a belladonna plaster had been put on a wound.

Atropine is normally prescribed in very small doses ; and yet the very smallest quantity can sometimes produce symptoms of poisoning. Fortunately there is a very wide space here between symptoms of poisoning and death from poisoning, much wider than in the case of most other poisons. Cases are known of children who have survived although they had taken five or six hundredths of a gram, i.e. about fifty times the permissible dose.

Cases of murder, committed by means of poisoning with belladonna or atropine, have always been pub-

lished by the criminologists when they were recognised. The best-known is the history of the poisoner, Marie Jeanneret. She was a Swiss, born in 1836. She was always eccentric and developed into a strange, possibly hysterical person. She had a passion for medicines, was continually consulting doctors, particularly on account of her fear of going blind—that was how she came into possession of prescriptions for atropine—enjoyed being treated by doctors, even if the treatment were unpleasant or painful, and finally, at the age of thirty entered an institution for the care of the aged as a nurse, taking no pay. A few months later she was arrested and accused of no less than six murders and of causing severe illness in three people, all through atropine which she had administered.

The first four deaths occurred in the home for the aged in which she was employed—where, by the way, two children were also taken ill. Among the dead was the proprietress of the home. Then Marie Jeanneret undertook private cases. She first nursed the mother-in-law of Bourcart the artist; very soon the lady's condition became so much worse and her symptoms so suspicious that the nurse was dismissed, after which the old lady's condition returned to what it had been before the advent of the nurse. The latter then quartered herself on a Mr. Gros. Soon after, his daughter fell ill and no doctor could find out what was the matter with her. Then Mr. Gros was also taken ill. Nurse Jeanneret continued to "care" for them both. Both patients died. When after that in another house in which Nurse Jeanneret was employed there was a case of illness diagnosed by the doctor as belladonna poisoning, she was at last arrested. She con-

fessed to the murders she had committed, as she said, by way of experiment, in order to study the effect of the poison. There is no doubt that this was not a case of murder for profit ; it must be assumed that she acted under a pathological urge. The police doctors at the time were, however, not of this opinion. The woman was sentenced to twenty years' imprisonment, although the prosecuting counsel had used the words " poisoning mania."

A strange motive induced a servant-girl of only fourteen and a half to poison her master, a doctor in Chemnitz, and his wife, by putting atropine in their beer. She had found the poison in the doctor's medicine-chest. The victims' lives were saved. The maid asserted she had believed that if her master and mistress were dead she would be able to return to her own home, a village in the Erzgebirge (Saxony).

There is another case (of an earlier date) of a sick nurse who poisoned with atropine one of the officials at the hospital where she was working. And in very recent times we have the story of the female innkeeper, Anna Auer, in Lower Austria, sixty years of age, who after having been married for thirty years, during which she had committed frequent and promiscuous adultery, attempted to do away with her husband by means of belladonna, because she had been seized with a violent passion for a new lover, a man of forty-five. She had made her first attempt with toadstools, then with arsenic, but was unsuccessful. Then she collected the roots of a deadly nightshade plant in the woods and cooked them in the form of a soup. When her husband had taken some of this, he suddenly became unconscious and fell from his chair. At first the doctor

diagnosed a stroke, but later he discovered that the patient had been poisoned. The lover denounced the wife and she was arrested.

The trial took place in Krems in March, 1931. The woman was sentenced to five years' imprisonment for attempted murder ; the husband recovered and forgave her. At the trial it emerged that the wife, immediately after the husband had collapsed, had had an intimate meeting with her lover. The psychiatrists declared the woman to be suffering from nymphomania and decided that the motive of her deed was a sexual aversion to her husband and attraction to her lover. The husband must have had an enormous power of resistance to poison, or else the repeated attacks on his life must have proved fatal. There are said to be people, by the way, who can eat the belladonna berries without taking any sort of harm.

In the case of many animals immunity from atropine poisoning—or rather belladonna poisoning—can be proved easily. Rabbits and guinea-pigs, for example, can actually be fed with the roots, leaves and berries of deadly nightshade ; dogs too, and monkeys, and of course snails survive such food—also many birds.

Belladonna contains other dangerous poisons besides atropine—in particular hyoscine and scopolamine. They are also to be found in all other varieties of nightshade plants. First among these after belladonna is the thorn-apple, which grows on rubbish-heaps or almost anywhere, and the leaves and seeds of which are poisonous ; the seeds are easily mistaken for poppy seeds. The same poison—hyoscine—is contained in henbane. Medicine makes use of these

herbs—in asthma cigarettes hyoscine is usually the active principle—and they are often found in popular household remedies ; this is, of course, a facile source of poisoning. Among the poisoning symptoms are hallucinations affecting both vision and hearing ; these are followed by unconsciousness and in severe cases by death. In the milder cases recovery has been known to take place even after several days.

Are these herbs employed with any frequency for criminal purposes ? It is said of gipsies that formerly they often utilised the narcotic properties in these substances. Probably also they play a great part in the magic practices of many fakirs and other wonder-men. A thorn-apple was once used in the year 1908 by fanatics in Indo-China who were attempting to massacre the whole European population of the capital Hanoi. The soldiers were given a meal which contained some of the poisonous plant, whereupon they became delirious ; they had visions of ants, did not recognise each other, shot at one another and so on ; this excitation, however, soon disappeared and the plot failed.

Henbane has similarly often been used for murderous purposes, and many other members of this dubious plant family might be mentioned in the same connection. The white bryony, for example, which grows in Lithuania, has most certainly been employed there in many cases for evil purposes ; then there is the mandragora, often used in past centuries for compounding sleeping-draughts—it must be remembered that scopolamine, which has sleep-inducing and narcotic properties, is also contained in these plants—and also a kind of hemlock found in Dithmarschen in

Slesvig, which is mentioned in old chronicles as having a soporific effect.

Two further plants belong to this group and have on occasion also shown its baneful properties. These are the tomato, the leaves of which, and even the fruit, when it is unripe, sometimes cause illness—and the potato. The buds and tops of the potato contain the poison solanine, which has much the same effect as atropine, and many a puzzling illness can probably be attributed to this source. Very little is known of these problems by the general public, and even scientific investigation has not proceeded very far in throwing light on them.

CHAPTER XIV

CYANIDE OF POTASSIUM

In the textbooks of forensic medicine the Hofrichter case will always have its place as one of the strangest murders ever committed by means of a poison.

On 17th November, 1909, Staff Captain Mader of the Austrian Army was found in his rooms by his servant in a dying condition. A letter lay on his writing-desk, broken off in the middle of a sentence on the third page. There was a drop of water on the page at the point where the writing ceased. The young captain's death could not be accounted for, the only thing that seemed certain was that he had been poisoned, so an autopsy was ordered which was carried out two days later.

Meanwhile, a search was made in Mader's rooms, in the course of which a small brown cardboard box of the kind ordinarily used by chemists was found in the desk, together with a letter from a firm entitled " Charles Francis " recommending a drug to counteract sexual weakness. Comrades of the dead captain remembered that on the fatal day he had received the package by the early post and had laughingly shown them the drug, which had been contained in capsules. More enquiries were made and it was discovered that eleven further officers had received packages identical with that sent to the dead staff-captain. The post-mortem revealed that he had been poisoned by potassium cyanide.

What followed was more dramatic than any crime film. The fact that the attempts had been directed

against young staff officers pointed suspicion against young officers who had something to gain by the removal of their superiors. The only clues were the little brown box and the ominous letter signed "Charles Francis." The box had been made by a Viennese firm which had, however, long ceased to produce that particular model; the letter had been hectographed on a machine like thousands of others in general use. But there was one trifling circumstance which led the investigators in the right direction. An officer attached to the garrison in Linz informed his superior officer that some time before, one of his fellow-officers had given him—on his birthday—a box exactly like the one described in the newspapers, decorated with feathers for a joke. The donor had been First-Lieutenant Adolf Hofrichter serving with the 14th Infantry Regiment in Linz.

Hofrichter was known to be a very ambitious soldier who had been trained at the Military Academy and then attached to the Staff without, however, succeeding in obtaining a definite appointment. There were too many who took precedence of him, more fortunate men of his own age, including Mader and the others to whom the packages had been sent. He had been transferred to the regiment in Linz only shortly before, i.e. on 1st May, 1909. Investigations were thereupon concentrated on Linz. A chemist in that city was discovered who had sold empty capsules to an officer; information was laid, further, that Hofrichter had been in Vienna a few days earlier where he had had an opportunity of posting the death-bearing packages, and at that stage it was decided to question him.

The Military Commission which held its sittings in the barracks at Linz, ordered a search to be made of Hofrichter's rooms, but before the search was carried out, the Commission, following the custom at the time, asked Hofrichter if he would not prefer to go on ahead. . . . Hofrichter reflected a moment and then said he would only enter his house together with the Commission. The result of the ensuing investigation was overwhelming. Two empty boxes of the particular type were found, out of fifteen which he had bought, as was proved. A firm in Linz was found which sold envelopes of the kind which had contained the prospectuses sent to the officers. In the Divisional Office —easily accessible to Hofrichter—there was a hectographic apparatus with ink of the same kind and colour as had been used in the covering letter from " Charles Francis." Then there was a herbalist in Linz who stated that some time before an officer's servant had been to him to ask whether he could buy potassium cyanide. The servant had presented a letter with a signature, followed by the words " First Lieutenant of the Infantry Regiment No. 14."

A few months later a court martial was held in the traditional manner. The windows were opened for the sentence, Hofrichter was found guilty, his stars were torn from the collar of his uniform and his sword broken in half. He was sentenced to imprisonment for life. His life was spared because the evidence was only circumstantial and there had been no confession of guilt. The revolution brought him his freedom. Unknown and under another name he is still living in Vienna.

The Ebergenyi case, too, is well known in criminal history.

On 23rd November, 1867, Countess Mathilde Chorinsky was found dead in Munich, poisoned with potassium cyanide. Investigations revealed that she had been visited a few days before by a lady from Vienna, the alleged Baroness Vay, with whom she had gone shopping and arranged to visit a theatre. In the evening, before the ladies started for the theatre, the strange lady had sent the woman with whom the Countess lodged for a carriage. When the woman returned she found the Countess' room locked and assumed that the ladies had left for the theatre without waiting for the carriage. When the Countess did not return either the next day or the day following that, the landlady informed the police. The Countess' room was opened and the Countess was discovered lying dead on the floor. The table was laid for a kind of high tea for two ; cakes, cold meat and fruit had been prepared, and the cups showed that tea had been drunk. There was no robbery.

The strange lady was sought in Vienna with great perseverance and she was discovered in the person of Julia v. Ebergenyi, a lady living in a charitable institution for gentlewomen. She confessed at once when she was first questioned that she had visited the Countess Chorinsky and poisoned her with potassium cyanide. The motive was not far to seek. Frau v. Ebergenyi had been carrying on a liaison with Count Gustav Chorinsky, the husband of the dead woman. Julia Ebergenyi, who was defended by Dr. Max Neuda, was sentenced to twenty years' imprisonment. The Count was accused of complicity and was also sentenced, but had soon to be transferred to an asylum, where he died shortly afterwards.

At the end of the eighteen-sixties there was another murder by means of potassium cyanide which claimed the attention of the Viennese police. One June day of the year 1869 a woman tobacco-dealer visited her friend, Leopoldine Hänsel, who offered her a liqueur. The visitor refused, as she thought the liquid had an unpleasant smell; the hostess, however, drank a glassful and immediately fell dead. Just before she drank she had said that "he" had given her the liqueur. It had been poisoned with cyanide of potassium and search was, of course, made for the donor. The dead woman, as was shown by the autopsy, had been pregnant, and the man responsible, as was discovered, was a tailor by the name of Leopold Winkler. He denied everything, even having known Hänsel at all. A child of thirteen, however, who during the trial called out "You asked about it," gave decisive evidence against him. She said that a few months before the woman had been poisoned, Winkler, when trying a dress on the child, had asked her whether her father used potassium cyanide (the child's father was an electro-plater). Winkler was at first condemned to death, then reprieved and, after he had been in prison for twenty-five years, released at the earnest request of his wife. He emigrated to America.

There have been other cases of murder by means of potassium cyanide, but suicides with this medium are more common. Doctors, chemists, druggists and photographers have frequently made use of it, being fully aware how quickly it acts. Potassium cyanide is a very important reagent and often to be found in laboratories kept in a glass vessel, and in former days without sufficient precautions for such a dangerous

poison. Photographers use it for developing and it is also employed in some industries. It has often caused fatal accidents.

In all these cases the poison agent has been potassium cyanide itself, a white crystalline powder. It is the potassium salt of hydrocyanic (or prussic) acid, a colourless liquid which frequently occurs in Nature. It is contained in bitter almonds, in smaller quantities also in the kernels of cherry-, peach- and plum-stones, in apple-pips, in the leaves of some trees, in the roots of certain species of beans, in short, Nature is very lavish with this poison. Poisoning may occur from all these sources and medical literature is rich in examples. A few plum kernels, a handful of cherry-stones may suffice.

Even a " burnt almond "—the sweet made of almonds and sugar—has been known to produce the typical symptoms of prussic acid poisoning and inspire the consumer with a terrible fear which, fortunately, unpleasant though it was, did not last long. Accidents with this poison happen most frequently when too much is taken of the medicine " laurocerasus " which is often prescribed, whereby, of course, the conception " too much " differs in individual cases. In this medicine prussic acid is contained in the proportion 1:1000. An ordinary prescription is twenty drops three times a day, a quantity which never—or, to be quite accurate, hardly ever—does a patient any harm. It has, however, been known to have unpleasant consequences even in such minute doses. More usually such poisonings occur when a larger quantity has mistakenly been given for the dose prescribed. One man, who had taken 60 grams, died an hour later.

Acute poisoning by prussic acid or potassium cyanide—if the dose is sufficiently large—often sets in with lightning rapidity. A few seconds of terrible fear, of sudden pallor, a short scream and it is over—death has taken place through paralysis of the respiratory centre. In most cases, however, even the lethal cases take several minutes—death is preceded by trembling, shortness of breath, convulsions and unconsciousness. As potassium cyanide is sometimes used (for example) by those who have access to it, for removing black stains from their hands caused by solutions of *argentum nitricum*, this also has given rise to accidental poisoning. Many such cases are known, ending fatally particularly when some small wound has facilitated the entrance of the poison into the tissues.

Chronic cases of poisoning occur when people's work brings them into constant contact with potassium cyanide, as in the case of chemists, galvanizers, dyers, photographers and so forth. The symptoms are headaches, sleeplessness, loss of appetite and severe nervous disturbances. Even in the case of acute poisoning the patient who survives is sometimes plagued for months by its effects. Probably prussic acid must be counted among the blood poisons ; there may be some analogy with carbon monoxide. The rapidity with which it acts, however, is very characteristic and cannot be explained merely by its effect on the red blood corpuscles.

Recent causes of poisoning from this source are the treatment of dwellings with gas and the gas campaign against noxious insects and pests. Lately, for example, gassing has been employed for destroying bugs in human habitations. The process demands great care, in order

that neighbouring rooms and people living in other flats in the same house may not be endangered. Prussic acid is used for this purpose or, more usually, cyanogen chloride prepared from sodium cyanide treated with hydrochloric acid.

Unless the greatest care is observed the consequences can be catastrophic. In December, 1930, ten inmates of an invalid home in Jitschin died after the home had been gassed ; they had been allowed to re-enter their rooms too soon after the process. A number of other cases are known to have occurred. A cyanide compound again is often used in the campaign against noxious insects and pests in woods and fields ; this also has led to tragic accidents, but so much progress has been made in the technique adopted for these purposes that accidents are now very rare. The Egyptian Government has an excellent organisation for ridding the orange plantations of harmful insects by gas ; here calcium cyanide treated with sulphuric acid is employed. The Italian Government uses the same method against the shield-louse ; in Spain the guild of "gassers," the *fumigadores*, boasts a large membership, and the corresponding work done in California is admirable. The treatment with prussic acid of the valuable altar of Kefermarkt, jeopardised by the xylophagan (wood-worm), aroused much interest.

Prussic acid has also been employed in the execution of criminals condemned to death ; several such executions have taken place in the prussic acid chamber of Carson City in the State of Nevada. The last time, it was recorded that death supervened in six seconds.

CHAPTER XV

STRYCHNINE

In the East Indies there is to be found a little tree with a short, thick trunk, with egg-shaped, bare-looking leaves and orange-coloured berries in the white, gelatinous flesh of which a few seeds are embedded. This is the *Strychnos Nux Vomica* or poison-nut tree, and the seeds contain strychnine, the well-known very strong poison. The seeds are broad and flat, about an inch in diameter, covered with satiny hairs and so bitter that nobody would be inclined to eat them. The bark of the tree, too, contains the poison, which is also found in Ignatius' beans, the seeds of the *Ignatia amara*, a tree belonging to the same family.

Pharmaceutical chemists obtain strychnine from the *nux vomica* seeds by a complicated process; the seeds are dissolved in boiling alcohol which is allowed to vaporise. When later nitric acid is added, a very bitter substance, hard to dissolve, is obtained. This is nitrate of strychnine, sold by druggists, though in no very great demand. It is occasionally needed, in small quantities which are, of course, quite harmless. When used medically it is as a stimulant. In ophthalmology it is employed (mostly as an injection) in cases of severe disturbances of vision; in cases of functional heart trouble it is sometimes used—possibly not often enough—and in some cases of poisoning, including alcoholism. There is no doubt that it is capable of doing good, but those who employ it must never forget that its effects are inclined to be cumulative, i.e. they last for some time,

so that on giving a second injection the first must be taken into consideration, even if two days have meanwhile elapsed. This precaution is necessary even when quite small amounts are given, as the remaining effects of older injections mount up and, when they have accumulated sufficiently, will quite suddenly produce the dangerous symptoms of strychnine poisoning, to the surprised horror of both doctor and patient.

They are truly horrible. Sometimes they are preceded by warnings such as a burning feeling in the stomach and vomiting—though the latter is less common than the name nux vomica would suggest. Sometimes such patients complain of a feeling of tension in the mouth and difficulty in chewing. Strychnine poisoning itself begins by cramps reminiscent of hysterics or tetanus. (These two last-named disorders, so different in their source and severity, have certain symptoms in common.)

In the typical strychnine cramp the head is drawn backwards, the hands are cramped, the whole body is bent like a bow in such a way that it is supported only by the back of the head and the heels. The patient foams at the mouth, utters terrible shrieks, and there is no merciful unconsciousness to deaden his sufferings. The cramp only lasts for a minute or two, which seem endless to the unfortunate patient. A lull follows, to be again succeeded by the contraction of the jaw muscles—the cramp is repeated, possibly induced by the very slightest touch on the patient's body or his bedclothes, by heavy footsteps in the room or even by a loudly spoken word. The lightest contact or vibration is a sufficient irritant. These cramps may be repeated

a few times, but not very often—the poison is stronger than the body's resistance and the patient succumbs to the attacks, generally in one of the lulls, mostly fully conscious, more rarely in deep unconsciousness. Sometimes only the first or second attack is very severe, the later ones proving weaker and allowing room for hope that the body will succeed in overcoming the insignificant amount of poison ; in such cases the patient remains in an exhausted condition for the next few days, but may recover. There have been cases where consequences of the poisoning have been felt for months with recurrent cramps in some muscular groups.

The strongly stimulative action of strychnine and its power to induce reflex cramps have been very intensively studied in experiments on animals. One millionth of a gram, i.e. a quantity so minute that it is almost inconceivable, suffices to produce cramp in frogs, so violent is the reaction of the central nervous system, particularly the spinal cord, to this poison. The diaphragm is also affected by it. Respiration is suspended, the heart ceases action in a kind of cramp. In the case of frogs the cramps follow one another so rapidly that there is no perceptible pause. It seems to be one single cramp affecting all muscles. Even plants react to this poison. Mimosa, that sensitive plant, that noli me tangere which ordinarily sheds its leaves at the slightest contact, tolerates fifteen times the ordinary weight when treated with a few drops of strychnine. The effect of the poison on the leaves seems to be to induce a kind of cramp even in them.

Hunters—particularly the Siberian trappers—use strychnine a good deal. In tropical countries, too,

hunters use it to destroy harmful animals. Burkart, for example, relates how he poisoned crocodiles who had been wont to feast on the herons he had shot. He put a gram of strychnine into each of the birds he shot and put them where the crocodiles would find them. Burkart describes the torments endured by the poisoned crocodiles whose corpses soon covered the river.

Strychnine also plays a great part as arrow-poison.

The known cases of strychnine poisoning have sometimes been caused by mistaken employment of medicines containing the poison. Strychnine poisoning as a form of murder, though generally known to exist and often mentioned, is not really (comparatively speaking) very frequent. It is more difficult to obtain than many other poisons. Still, there have been cases, even in recent times. In May, 1931, for instance, an officer in Klattau received a parcel of apples, one of which he ate. Soon after he was seized with violent symptoms of poisoning. The doctor diagnosed severe strychnine poisoning. The officer's life was saved. Strychnine was found in all the apples which had been contained in the parcel. The sender was never discovered—it seems to have been an act of revenge on the part of a girl.

In the spring of 1932 a gendarme was arrested in Gleiwitz and therewith a poisoning mystery solved which had greatly excited the inhabitants of that city. The victim had been a Mrs. Müller who had been the gendarme's mistress. In the end he had tired of her, there had been scenes and an action for maintenance of the illegitimate child; this had not been decided when the woman died suddenly of strychnine poisoning. A man had offered her sweets which had contained

strychnine. Later it was proved that this man had been the gendarme himself. A note-book with a note on the purchase of the poison betrayed him.

In earlier days many murders and attempted murders were undertaken with strychnine. Suicides, too, occurred repeatedly.

The trial, years ago, of Horsford who had murdered his mistress (his own cousin) caused a great sensation in England. The man had induced her to take the fatal pills by telling her that they would prevent her becoming pregnant. The same pretext was used by a pharmacist in Prague, who poisoned his wife with strychnine poured into a glass of Malaga. One of the oldest known cases of murder by strychnine poisoning occurred in the year 1856. An English doctor called Palmer poisoned his friend Cook. A few years later something similar happened in Berne where another doctor—Dr. Demme—poisoned a merchant named Trümpy with strychnine. The last-mentioned trial caused a great sensation because the expert declared that so large a dose as had been given in this case could not have been administered to anybody against his will; the exceedingly bitter taste would have prevented it. It is true that for this reason a great many attempts at murder by means of strychnine have been unsuccessful, as it is one of the bitterest substances in existence. That is why strychnine has often been administered in coffee which, with the assistance of chicory, tends to hide the bitter taste. Another case is known of a woman who poisoned her seven-year-old little daughter by giving her wheat treated with strychnine, which is often used in the country for poisoning rats and mice. There is also a

known case of fratricide with this poison. A woodcutter sent some cakes to his brother as a Christmas present, having first poisoned them with strychnine. The murder was later discovered by chance.

At the beginning of the eighteen-nineties there was a terrible (criminal) tragedy in Brighton. A poor sempstress named Christine Edmunds fell in love with the husband of one of her customers—a doctor by the name of Board ; when she found he did not reciprocate her passion she determined to kill the wife. She visited her, brought her flowers and sweets, the latter having been poisoned with strychnine. The lady, however, only tasted them and then handed them over to her husband to examine, as her suspicions had been aroused. The husband found the poison, sent for the sempstress and reproached her violently, but did not inform the police. Edmunds rid herself of the rest of the poisoned sweets by mixing them secretly with others exposed for sale in various shops in the town. A number of deaths and several cases of severe illness were the consequence. Finally, these mysterious cases of poisoning were cleared up and Edmunds was brought to trial. The matter caused a tremendous sensation. Dr. Board was of the opinion that the woman must be mad, and the Court agreed. She was sent to Broadmoor, where she died as a very old woman in 1929.

Then there was one case of mass poisoning by strychnine. The murderess was another mental defective, also of Brighton, who used cakes as her medium. A number of people ate them and, on the sudden death of one boy, the matter was cleared up.

In 1896 a tragedy occurred when a chemist sold

strychnine instead of phenacetine and caused the death of two persons. An employee of the wholesale firm was to blame for the catastrophe ; he had marked the containers of the medicines wrongly. Another tragic case was that of Dr. Dick, an Englishman who prepared some medicine for one of his patients which made her so sick that she called him in again. In order to show her that the medicine was harmless he took some of it before her eyes and died soon after of strychnine poisoning. He had confused two unlabelled bottles with each other.

Accidents have also happened when poisoned bait has been spread for noxious animals and has been eaten by humans. This has happened fairly frequently when strychnine has been used for rat-poison.

Though human beings and many animals react violently to strychnine, here again, as with other poisons, we find animals who are not harmed by a little strychnine. It does not hurt fowls, and it is said of the rhinoceros bird that it is particularly partial to the nux vomica seeds. People who are saturated with nicotine—that is, heavy smokers—are said to have acquired a certain amount of protection from this poison, while on persons too much addicted to alcohol strychnine is said to have the effect of making them dislike their liquor. Nevertheless, strychnine is not to be recommended as a cure for alcoholism—the cure might prove too radical.

CHAPTER XVI

POISONOUS FUNGI

In the summer, when the thirsty earth of the woods is saturated with water after a day or so of rain, fungi make their appearance ; they shoot up suddenly —singly, in small groups, or in a large colony as the case may be. They appear in very many forms ; some flat-capped, some tuberous, some stipiform, some cup-some club-shaped, some smooth, others spiky, some with leaves and so on. There are beautiful specimens among them, others which are strange and grotesque ; some look most attractive, others are slimy and evil-looking. Also they are found in hundreds of colours. Their shades vary from pure white to black or deep violet—they may be scarlet, yellow, pale pink or brown—as a rule the colours are mixed, but the typical green of a leaf is always lacking. The fresh colour of tree leaves, of meadows, is never to be found in fungi, their cells have no chlorophyll, no leaf-green.

From the biological point of view this is the most important characteristic of fungi, and this explains its mode of nourishment, which consists of matter already prepared by animals and other plants. Most probably it also explains why its albuminous content must be looked upon differently from other products of the animal and plant worlds with nutritious qualities. In this case chemistry diverges from biology. Chemists find in fungi a considerable content of albumen and a caloric value of thirty to forty in the case of fresh, of two hundred to two hundred and fifty in the case of

dried fungi—that is enough to make it seem justifiable to call fungi the meat of the forests and to recommend their use as a cheap article of food for large numbers of the population.

Nevertheless this is not the case. The human organism can only tolerate a fraction of this nutritive content, however good the subject's digestion may be —not even when the fungi are powdered so that a certain amount of the albumen is released from the cells. On the whole the nutritive value of fungi is about equal to that of other vegetables. They are, then, valuable, all the more because many mushrooms taste delicious and are worth the trouble of collecting and preparing. But one must not assume their value to be greater than it really is, nor believe that half a pound of fungi is sufficient to make up the necessary daily quantity of albumen in human consumption. All honour to mushroom gatherers, but the very important point is that these must also be experts on the subject.

Certain so-called general rules exist by which poisonous fungi can be recognised, and these are all inadequate. True, it is easy enough to avoid unappetising-looking, slimy, insect-laden and obviously stale specimens, but it is a mere superstition to assert that poisonous fungi colour silver spoons brown, that they turn onions black and salt yellow. These popular tests do not carry us very far. It is correct that all the lamella fungi should be avoided excepting champignons and the yellow merulius. Nearly all forms of the milk agaric, particularly those containing a reddish or watery juice, should be avoided; also the boletus, which may very well be poisonous. These are general

rules, but the principal rule is that nobody should collect fungi unless he knows them very well indeed.

The number of cases of poisoning that occur every year show that this rule is very often neglected. Formerly it was believed that all fungi were poisonous when they occurred in a so-called unhealthy place. This is certainly not correct, but on the other hand there are some fungi which have a varying poison content. Moreover, it may happen that some people react violently, others hardly at all, to the same poisonous fungus. In the case of all fungi the poison penetrates into the water in which they are boiled ; they can, therefore, be deprived of their poison content by boiling (a process not approved by gourmets), if the water is poured away. But if in such a case one person only eats the cooked fungi, whereas the other takes some of the liquid as well, the effects are, of course, very different.

One of the best known of poisonous fungi is the fly-agaric (*agaricus muscarius*). Seldom, however, does it cause poisoning, as mushroom gatherers are well acquainted with its scarlet colour and white spots and avoid it. It has been very thoroughly investigated by scientists who hope from their studies to discover the secret of fungus poisons, but without conspicuous success.

In the year 1869 Schmiedeberg discovered as the active poison of the fly-agaric a substance which has been called muscarine, but to-day it has again become doubtful whether this is really the actuating principle of this fungus. A very small quantity suffices to kill human beings and animals. Many of the poisoning symptoms are reminiscent of those of belladonna—

they are usually vomiting, colic, fainting, sometimes violent excitement, enlargement of the pupils. As in the case of all fungus poisoning they should be combated by emetics, purgatives, stomach lavage, black coffee and camphor injections. But it is by no means certain that the cure will even then be successful, as the poison in this fungus is very strong.

The *marasmius urens*, the False Champignon, has perhaps most often given rise to fatal mistakes. It can easily be taken for the much-prized true champignon, although the latter has pale pink or brown gills while those of the poisonous species are "innocently" white. Mass poisoning from this cause has occurred repeatedly and been described in medical journals. The symptoms are reminiscent of cholera, even including the tormenting cramps in the calf of the leg characteristic of that disease. Other kinds of cramp, too, have been observed in these cases, caused by the effect of the poison on the brain and spinal cord. Often, and this is a bad sign, the symptoms of poisoning do not appear until several days after the fatal meal. Death ensues after two or three days, sometimes not till a week later, and it is very seldom that a sufferer from this kind of poisoning can be saved.

Nearly all milk-agarics among the fungi are poisonous. An exception is the Orange-Milk Mushroom (*lacterius* or *agaricus deliciosus*) which has orange-coloured juice and is very popular everywhere. It is the fault of this mushroom that many a poisonous milk-agaric has found its way into the kitchen, particularly the Sharp Agaric (the *agaricus torminosus*), which, especially when it is young, has a most attractive appearance. It has certainly proved poisonous in our

districts, although some experts assert that the variety found in Sweden can be eaten safely.

The genus *russula* is similar to the milk-agarics. Some of the former are edible, but many are definitely poisonous, among them the much-dreaded *russula emetica* which is very attractive-looking and found in the woods in the summer and autumn ; at first it is rose-red, later blood-red, sometimes yellow or white. It causes vomiting almost immediately. Its effects may last for some days, but its consumption is not usually lethal.

Other poisonous fungi could be mentioned such as a species of bovista reminiscent of the truffle, the " sulphur-head " which, however, generally warns the would-be consumer by its bad taste ; then there is the *amanita pantherinus*, and many others. These latter, however, are of no great importance, most cases of poisoning are caused by those mentioned earlier.

There is something mystical about all poisonous fungi, but perhaps the most mysterious is the one the Germans call Lorchel (one of the *Helvellacei*). It has been described as being a toxicological riddle. It occurs early in the year, in April, often in large groups. It has an irregular stem and an irregular brown "hat," fibres from the stem running up into the hat itself ; it has very tender flesh. It has a pleasant taste and some people are very fond of it, but it is nevertheless poisonous, though possibly not always. It is certain that year for year it has caused severe poisoning, even deaths. The poison is almost entirely absorbed by the water in which it is boiled, so that it can be deprived of its poison by boiling if the liquor is poured away ; these mushrooms are also non-poisonous when

they are dried. Their poison (or one of them) is helvellic acid.

It is a most extraordinary fact that many people can eat this mushroom for years without taking any harm and then suddenly fall very ill on one occasion when they have made a meal of it. As in most cases of mushroom poisoning the symptoms are vomiting and diarrhœa, exhaustion; also violent pains in the abdomen, disturbed vision, a feeling of suffocation, restlessness, cramps, until the fate of the patient is decided. The poison is a blood poison which destroys the red blood corpuscles, and autopsies have shown the devastating changes brought about in the internal organs by this destruction of the blood. Experiments on animals serve to demonstrate the effects of this poison.

It is important to point out these facts because this particular mushroom is found very often in the German pine woods and is brought to urban markets in great quantities in the spring months. The German Mycological Society has often called attention to the poisonous nature of the lorchel and demanded that, as in Austria, it should be excluded from the markets. The Lorchel is often designated—wrongly—as Morchel. " Morchel " is the *morchella esculenta*, an edible variety of the *helvellacei*, to which the lorchel also belongs. This genus of mushroom forms its spores internally in large tube-shaped cells.

The records of all ages contain many cases of mushroom poisoning; individual cases, poisoning of families, of whole schools and similar catastrophes have been very frequent. There have also been cases of murder by poisonous fungi and the author Oskar

Jellinek, so to speak, introduced mushroom poisoning into literature by describing in one of his stories a case of mass poisoning, purposely engineered, from this cause. In classical Roman times some murders seem to have been committed by means of mushroom poisoning ; it would have been possible, but it is more likely that a stronger poison was added to the food in these cases. We are told of at least one Roman empress who widowed herself by this means.

CHAPTER XVII

FOOD POISONS

Newspaper report: "After partaking of vanilla ices twenty persons were taken very ill yesterday in X." This is a typical notice. Poisoning from ices, from sausage, from fish. It is nearly always the same cause, namely the paratyphoid bacillus, which externally and biologically is so similar to the typhoid bacillus that the greatest bacteriological experience was necessary to discover it at all. It is now very well known and minutely described in every textbook on bacteriology; it can always be found when it has caused a case of illness or an epidemic. It has many peculiarities and it is not known whether it represents one single type or a group of relations which resemble each other very closely, but are somewhat differentiated in their natures.

The paratyphoid bacillus is often found in perfectly healthy people, but that is the case with many other bacilli also, for example, the genuine typhoid bacillus. The carriers of bacilli, that is the people carrying and spreading them and thus becoming unrecognised sources of infection, represent a medical problem which has not yet been fully solved. The paratyphoid bacillus is, of course, not always harmless in regard to the person in which it resides. It can behave in precisely the same way as the genuine typhoid bacillus and produce a type of illness exactly like real typhoid. This is the milder form of paratyphoid infection. The more dangerous form is that

of an acute catarrh of the stomach and intestines very like cholera.

A number of animal diseases are caused by paratyphoid bacilli, such as, for example, the typhoid found among mice. In doubtful (human) cases a mouse may be infected for experimental purposes in order to decide whether the case is one of paratyphoid or not. The answer, however, is not always clear. Often again the bacilli are found in healthy animals without harming them until one day they are given some unsuitable food, for example, sausage or other meat suspected of having caused poisoning.

Food of this kind, by the way, is often deceptive, and paratyphoid bacilli (causing serious illness) have been found, for example, in perfectly appetising, clean-looking sausage meat.

Sausage and various kinds of meat are the most frequent sources of food poisoning, but other forms of food can also cause the poison symptoms just described. Often, though perhaps not always rightly, oysters are said to be the cause ; also milk, cheese, bread, eggs, puddings, and particularly preserved food. Sometimes the very smallest quantity—even a single bite—may have the most violent consequences ; and, as is obvious, cases of mass poisoning are not uncommon. A large joint of meat prepared for some festivity may contain paratyphoid bacilli and thus poison all those partaking of the meal. These mass poisonings are more often made public than individual cases—there have been notices of mass poisonings for centuries.

Other bacteria sometimes contained in sausage meat have also been known to produce poisoning in the form of an illness known by the name of botulism

(though other kinds of food poisoning are often very similar and just as obscure as this is). It may be days before these food poisons take effect, at other times the results set in quickly. Sometimes the symptoms immediately point to the danger of the condition. Deaths are very frequent. In a home for the aged in Alicante in Spain sixteen persons became ill (at the end of September, 1931) after eating smoked meat; fourteen of them died in the first two days.

As regards preserved food it is, curiously enough, not meat and fish preserves which are the most dangerous, but preserved vegetables. Preserved beans have been known to induce very severe poisoning, including mass cases. In the case of some preserved string-beans it was shown that it was a poison produced by the bacteria and not the bacteria themselves which had caused the illness. A few thousandths of a gram of this poison are sufficient to kill a rabbit. Preserved bean salad, too, has been known to produce mass poisoning.

In the year 1904 a case of mass poisoning occurred in a cookery school in Darmstadt. On that occasion Professor Gaffky found the bacillus botulinus and discovered as a new scientific fact that this germ was not confined to animal tissues, but could develop and produce its poison also in vegetable matter. At the same time he discovered that the principal disturbances which followed poisoning from this cause were the same in animals and in human beings, that is, the poison affected mainly the central nervous system producing cramps and paralysis.

The poison from the bacillus botulinus was then carefully investigated and it was shown that it could not tolerate high temperatures and was therefore destroyed

when the preserved food was re-boiled. But the bacilli themselves cannot tolerate the oxygen in the air, they can therefore only develop when air is excluded—a very important point. The catastrophe in Darmstadt had very considerable dimensions : twenty people were taken ill and eleven of them died.

In the case of fish and meat preserves a swelling of the tins suggests that gases have been developed as a product of decomposition. This is a warning which must not be neglected. Fish preserves, though often suspected of being the cause of stomach disorders, are not really more harmful than other preserves. It has, however, been discovered by experience that the contents of an already opened tin should be eaten as quickly as possible.

Poisoning from meat is not identical with the septic virus in corpses. When albumen is decomposed, poisonous substances known as ptomaine are developed. Chemically these products of decomposition are similar to certain plant poisons. Very little is known about decomposition poisons. The symptoms of poisoning are those of very severe illness and it is well known that deaths from this cause are frequent. It is interesting to note that these poisons are formed at the very beginning of the decomposition process ; when this is at its height, that is, when a very penetrant smell has developed, then the poisons themselves are mostly already decomposed, i.e. no longer in existence.

In this connection a different form of food poisoning should be mentioned, notable for many reasons. This is poisoning from ergot (*secale cornutum*). Ergot is the intermediate stage of the (biologically very interesting) development of a fungus of which there are

three phases. When grasses and rye are in bloom it may often be observed that a kind of delicate white fungus is covering the bud, which later exudes sap. The peasants call it honeydew, and early botanists considered it to be a peculiar kind of fungus. In time this felt-like substance thickens, forming the so-called sclerotium, horn-like, nearly an inch long and dark violet in colour. This is the ergot, scientifically speaking the permanent home of the spores of a fungus which does not reach its highest phase of development, its final form, till some time later. The following spring, when from the ergot, that is to say the seeds, the little purple heads of the fungus (belonging to the order of ascomycetes) shoot up in the tilled land, forming the third phase of development, the spores are ready to be sprayed by the spring winds on to the rye blossoms, when the cycle of development recommences. The hard sclerotium is the actual ergot, the carrier of the notorious poison, which may easily find its way into grain, flour and bread, if particular care is not taken to search for it. The consequences of ergot poisoning are very serious. Both acute and chronic forms are known. In the acute cases the patients often suffer from tickling, as of something creeping under the skin, which is why it is sometimes known as creeping-sickness (its other name is ergotism). Hands and feet " go to sleep," the patient feels pain in the breast and in the tongue, vomits, feels giddy and suffers from hæmorrhages ; the skin may swell, bleed and become gangrenous. In pregnant women the poison leads to miscarriages.

If bread poisoned by ergot is eaten for a long time continuously the chronic form of ergotism ensues. This

produces cramps of various muscular groups, gangrene of the skin and even of whole limbs, in addition to the symptoms mentioned.

The dangers of ergot have been widely known for a very long time, but it still finds its way into flour occasionally. Its presence can be detected in bread by the occurrence of dark violet spots. The danger is particularly great when there has been a bad harvest or the summer has been very rainy ; efforts are, of course, made to minimize it by warning farmers and by control as far as possible of the markets. The poisonous substances contained in ergot have been scientifically investigated. Probably they are of three kinds, all liable to cause cramps in the involuntary muscles. In medicine ergot is sometimes used on account of this property—in obstetrics to further the labours of childbirth. Naturally, if it is wrongly used it causes great harm, and has been known to do so.

CHAPTER XVIII

PHOSPHORUS AND SULPHUR

It is some decades ago now since nothing but sulphur matches were to be found in all kitchens and in every household. Any other kinds which existed were rare and only used sparingly as a luxury. This has changed—perhaps with the rise of cigarette smoking—and "safety matches without phosphorus or sulphur" have to a great extent replaced the others. The latter as is well-known, could be struck on any hard surface, as their heads contained as principal constituents phosphorus and sulphur, phosphorus being of these the more important.

Later, the manufacture of matches was much improved. The sulphur was eliminated as diffusing unpleasant vapours, and the phosphorus transferred to prepared surfaces for striking. These were the "Swedish" matches, and the more quickly they replaced the old sulphur match the sooner such police notices disappeared as "Yesterday the maidservant So-and-so poisoned herself by swallowing the heads of two packets of matches." It must be admitted, however, that such cases still occur sporadically, as in July, 1935, in Vienna, when a professional dancer drank a solution which he had concocted of grated match-heads.

The first matches appeared just over a hundred years ago—in 1832. Kammerer and Preshel in Vienna and Moldenhauer in Darmstadt produced them, and in such a useful form that they very soon superseded

the clumsy lighters of the past. Austria remained in the lead of the manufacture and continuous improvement of matches, till she was outpaced by Sweden. Matches then offered would-be suicides a new medium for carrying out their purpose and poisoners a new murder-weapon. In the decades which followed more murders were committed by means of phosphorus than by arsenic, and the statistics of those who committed suicide with the help of phosphorus reached increasingly high figures. Phosphorus matches played the part later taken over by lysol and still later—in post-war times—by coal gas.

Phosphorus has an interesting history. In its pure form it is not found in Nature, but there are rich stores of it in combination with metals and with lime ; also, of course, phosphorus is an essential part of the bones of the body. At first pure phosphorus was obtained on a large scale from burnt bones ; it is a colourless whitish transparent substance with curious properties. It melts at a low temperature, oxidises in the air, shines in the dark (hence its name which means light-bearer) ; and when oxidising, i.e. when lying exposed to the air, it develops sufficient warmth to melt itself, even to cause combustion, so that pure phosphorus has to be stored under water. It is not soluble in water.

If the sun is allowed to act on phosphorus or if it is heated to a high temperature in a neutral atmosphere, ordinary white phosphorus turns into the red variety. Chemically this is a most interesting and practically unique process by which an element is given a different form with different properties. Above all, this red phosphorus is not poisonous, does not shine, is not combustible by friction. When it is

heated to a high temperature it burns and turns back into the first variety, the white, the poisonous, the easily melting kind. We have to thank the Viennese chemist, A. v. Schrötter for the description of red phosphorus, on which he reported at a historic meeting of the Academy of Sciences in Vienna on 9th December, 1847.

The heads of "sulphur" matches—the sulphur vapours were noticeable, the effect of the phosphorus unperceived, hence the common description—were, as already mentioned, the medium by which from the sixties to the nineties of last century many people found death. As it was used by many women because phosphorus produces abortion (more often, however, death), Kratter maintained that it was a "woman's poison" in the main; he calculated that during seventeen years in the town of Graz there occurred 150 to 200 cases of death through phosphorus, a very high figure for a city which then had few more than 100,000 inhabitants. The figures were similar in other cities. Round about the year 1900 it was noted that in Prague there still occurred over a hundred deaths per annum from phosphorus poisoning. Some Swedish statistics show the tragic effects of phosphorus when taken to procure abortion. In the half-century from 1851 to 1903 there were 1408 cases of phosphorus poisoning for the said reason. Only ten of these women's lives were saved.

Apart from these unhappy women there are approximately as many who swallowed the heads of a packet of matches with the intention of committing suicide. Men also made use of this medium. There have also been cases of phosphorus poisoning from

other methods. There is a kind of rat poison which contains a phosphorus mixture and has often been the cause of phosphorus poisoning, either suicidal, murderous or accidental. On one occasion two brothers were the victims of a tragic accident : a third brother, a baker, had accidently mixed rat poison with the flour he used to bake a cake for his brothers. A case was reported of a child who died after swallowing a piece of firework—a rocket which contained phosphorus. A number of murders are known to have been committed with phosphorus, particularly in the form of rat poison ; some of the victims were children.

The consequences of consuming half a packet—still more when it is a whole packet—are soon apparent. But the first symptoms of phosphorus poisoning are not so violent as those of some other kinds of poisoning, and it may be some hours before they appear. At first they seem obscure. Choking in the throat, pain in the abdomen ; later vomiting, whereby the vomited mass shines in the dark ; diarrhœa is nearly always present. It has often been noted that the breath smells of garlic. Often there are hæmorrhages, but not always. After three or four days the most characteristic symptoms of phosphorus poisoning set in, i.e. jaundice, combined with a swollen liver.

It should, however, be noted that a disorder of the liver exists which shows almost the same symptoms, the so-called acute yellow atrophy of the liver, the cause of which has not been satisfactorily cleared up. The two disorders are, at least for a time, almost exactly similar, and in both the prognosis is exceedingly bad. Occasional cures have been known, but if more than a very small quantity of phosphorus has

been consumed the prognosis in cases of acute phosphorus poisoning is definitely fatal. The minute quantity of a tenth of a gram is sufficient to bring an adult the torments of death by phosphorus poisoning. The source of the poisoning is easy to find—the phosphorus deposited in internal organs is still discoverable after weeks.

Besides the acute there is a chronic form of phosphorus poisoning. It occurs almost exclusively in the case of people who in consequence of their work come into continual contact with phosphorus, that is to say, workers in factories which produce matches. The symptom generally described in great detail as characteristic of chronic phosphorus poisoning (though it only occurs in some of the cases) is the necrosis of the jaw, i.e. the mortification of a piece of the jaw bone. Whether the occurrence of this necrosis of the jaw is connected with teeth affected by caries or whether there is some other decisive factor is not known for certain. It is, however, notable that it is not always present.

From Swiss statistics we learn that in a period of ten years in the factories concerned in Berne, about 10 per cent of the workers were attacked by this disease, that is, necrosis due to phosphorus. First, the gums swell, the teeth are loosened, fall out, all the teeth are painful, the jaw bone becomes bloated, fistulæ are formed, the bone, so to speak, disintegrates and drops off piecemeal. It is very strange that the process is so localised that only the jaws are affected, and it is also strange that phosphorus should be capable of thus injuring the bone while on the other hand it is well known that small quantities of phosphorus stimulate

bone formation. In the mixture of cod-liver oil with phosphorus, for example, which is so often given to small children suffering from rickets, phosphorus is a most useful ingredient.

Chronic phosphorus poisoning is not confined to match factories ; both the acute and the chronic form occur in other works. It is, for instance, found where acetylene is used, as this substance includes a not inconsiderable quantity of phosphuretted hydrogen. It is also found in the production of superphosphate, much used as manure. This is particularly true of " Thomas " slag, consisting of calcium phosphate and obtained from pig-iron by the basic process ; this, as is well known, is an excellent manure. In all these cases social hygiene has adopted measures for protecting the workers which have almost everywhere been successful.

The older match heads contained, as has been said, both sulphur and phosphorus. The actual danger came from phosphorus, while the sulphur was merely unpleasant. On the other hand, severe poisoning may be caused by sulphur. Pure sulphur taken in considerable quantities can have a lethal effect. This may happen by accident or may be a form of suicide. But of greater significance is poisoning by sulphuretted hydrogen gas, in other words by sulphur vapours. Such poisoning can occur in various kinds of industrial works in which sulphur is used, in laboratories and probably most frequently in canals, cesspools, shafts, and so on. The symptoms of the poisoning vary according to the quantity of sulphuretted hydrogen which has been inhaled—they are graded from a slight feeling of illness to long invalidism with

unconsciousness, fever, inflammation of the intestines, or even to sudden death. A dog who for experimental purposes had been made to inhale air containing 2 per cent of this gas died within a few minutes.

Reference was made to such results of experiments on animals when the deaths of two men which had occurred in German Altenburg in 1931 were investigated by the Courts. In this ancient watering-place (the baths there had been in existence since 1549) a vat in which the waters were collected was to have been mended by a labourer. The labourer, however, fainted while at work ; one of his fellow-workers went to his assistance and also descended into the vault containing the vats. He too must have become unconscious immediately. The men were not missed till the next morning when a search was instituted ; they were discovered as corpses, having been poisoned by sulphuretted hydrogen. The sulphur springs were analysed and it was shown that since the previous examination in the year 1899 their sulphur content had risen by 50 per cent.

CHAPTER XIX

LEAD AND MERCURY

The heavy metals, on account of their attraction to the cells of human and animal organisms, form an interesting chapter in the field of poison investigation, though the statement that all heavy metals are intensive poisons for all living things is now regarded as an exaggeration. It is, however, certain that lead, almost the heaviest of the heavy metals, is one of the greatest poisons in existence.

That has always been known and, though it was not always taken into consideration, as when, for example, the aqueducts in Ancient Rome were conducted through lead pipes, murderers of that period knew very well the powers contained in these colourless transparent crystals which taste so sweet that they are known as sugar of lead. In considering lead it is not only necessary to think of the heavy metal itself which everyone knows, but also of the many compounds formed by lead with other substances and producing lead salts of different kinds.

Sugar of lead is one of these, that is lead acetate. In ancient times it was very often used for criminal purposes. Also then as now women were often harmed through using plumbic oxide, i.e. a combination of lead and oxygen, or white lead (carbonate of lead) as hair dyes and cosmetics. White lead is very widely used in paints. This fact has caused poisoning of painters and decorators in numerous cases. There is also a yellow plumbic oxide, that is massicot, and a

red oxide of lead (or orange-lead), much used as a pigment, also a brown lead used in the dyeing industries; further there are combinations of lead with sulphur and with phosphorus, in short there are a great number, all useful to man, but all containing lead with its poisonous properties. If the necessary care is taken, however, the poisonous effects can be avoided.

The subject of lead poisoning has been very extensively discussed, but that chapter of it which deals with criminal cases in recent times is very short. In the year 1925 a woman and her lover were sentenced to death because they had removed the woman's husband by putting lead-white into his food. He had suffered long and very painful invalidism, the doctors were unable to diagnose his case rightly, and the true cause was not found till the body was exhumed and lead was found in the tissues by chemical analysis. Such cases are certainly very rare at the present day. Somewhat more frequent are cases of severe and even fatal poisoning when salts of lead are taken, as sometimes happens, by women to procure abortion. The "female pills" containing lead, and often taken in England for this purpose, have certainly caused the deaths of many women. There have been other accidental forms of fatal poisoning. Preparations of lead are often used for compresses, and though a large quantity of a lead solution used for this purpose would be necessary to have severe results, such cases have often been reported. As is comprehensible, children are most easily jeopardised by this means. It is injudicious to use either the aqueous solution of lead (lead acetate) or lead ointments over a large surface of the body, as this naturally very greatly increases the

quantity of lead absorbed by the cells. Statistics have shown that, for example, in Prussia there are from ten to twenty annual deaths from this cause.

The symptoms of acute lead poisoning do not appear till some hours after the poison is taken. The first symptom is a feeling of sickness combined with a taste of metal in the mouth ; this is soon followed by vomiting, pains in the abdomen and a cold sweat, the heart does its work with difficulty and irregularly, the functions of the kidney are not properly performed, the patient is in a state of over-excitement which may even become violent, then follow cramps and paralysis, succeeded by death.

But the acute cases, tragic as they are, play no very important part in the discussion of lead poisoning. Chronic poisoning, which occurs in many industrial works in spite of all hygienic precautions, is of very much greater significance. Its symptoms have been thoroughly investigated and are known to every doctor.

Persons affected by chronic lead poisoning first show their diseased condition by their curious colouring, which varies from slate grey to yellowish grey and is most clearly perceptible in the face. The second symptom apparent to the doctor is a layer of lead deposited on the gums. Though not always present, it is very common in these cases. Its colour may be slate grey, dark grey, or even blue-black ; it may be a narrow ridge or a wide strip edging the now spongy gums. It consists of genuine lead (colloid lead) secreted by tiny blood vessels, combined with sulphuretted hydrogen from deposits on the teeth. Chemical analysis may be used to make sure in doubtful cases that the lead is really present. The state of the teeth

and the gums may have a decisive influence on the possible appearance of this lead ridge ; the younger the person, the better the condition of the teeth, the sooner lead poisoning must be suspected when a ridge appears. An examination of the blood is also of relative importance. Where there is lead poisoning the red blood corpuscles acquire the property of changing their colour when treated with alkaline dye stuffs—they change to a blue shade on a dotted ground. It may be important to make sure of this, though it tells us nothing more than that something is wrong, that the organism is putting up a fight against some poison.

Among the many symptoms troubling a person affected with chronic lead poisoning, colic is the one most feared by the patient. Lead colic is a very severe colic of the intestines, comes very suddenly and causes intense pain, principally around the navel, but distributed in the whole of the abdomen, extending to the part around the kidneys and into the thighs ; the person affected can hardly breathe until the attack subsides or he is soothed by a morphia injection. These attacks may recur sporadically even years after a worker who has once been poisoned has ceased to be occupied with lead.

Paralysis of the radial nerve is a fairly common symptom in such poisoning cases. Usually it appears quite suddenly. The patient awakes one morning to find his hand paralysed, hanging down limply, incapable of exerting pressure, his fingers practically useless, incapable or almost incapable of performing such duties as buttoning a shoe or a coat. Vision may also be affected. This takes various forms, possibly a sudden blindness which, however, soon

gives way to normal vision, or a slowly developing inflammation of the optic nerve which leads to permanent injury. There are other and very varying forms of chronic lead poisoning.

Very many groups of people may be affected by chronic lead poisoning ; miners, workers in foundries, type-setters, painters, artists, glaziers, workers in lead cable factories, cutlers, dyers, weavers, the makers of some instruments and toys ; these are some examples, it is impossible to enumerate all the professions which are concerned with lead and are therefore liable to lead poisoning. When the symptoms described appear in workers in such industries the diagnosis of lead poisoning is simple. But there are also numerous cases of lead poisoning, the cause of which is at first quite obscure, and where intensive investigation is necessary, or where a pure coincidence serves to clear up the matter. At some railway station, for instance, some of the guards may fall ill with the typical symptoms of lead poisoning. They assure the doctor that they have nothing to do with lead. The cause is their new whistles, the mouthpieces of which are made of lead. Another case—a whole family is taken ill, the cause is at first entirely obscure. Finally, it is found in new mattresses, the horsehair of which has been dyed with lead salts. Again, poisoning has often occurred through kitchen pots made with lead—or even from sorting stamps, the colours of which contain lead. It is impossible to give an exhaustive list of sources.

In the summer of 1930 an extraordinary number of persons was taken ill with lead poisoning in Leipzig. The cases were confined to people who were living in new houses built the year before. The lead pipes of

the water supply were found to be the cause and an edulcorating plant had to be installed in the municipal water pipes. This helped, but did not entirely destroy the evil, so that, for example, the orthopædic clinic in Leipzig (which was also a new building) decided to have its lead replaced by iron pipes.

In the mountain village of Sonnleitberg in Styria strange cases of illness affecting the inhabitants of two neighbouring farms occurred in 1931. Various, even exotic, diseases were thought of until a ridge was noted on the gums of the patients and the examination of the blood made certain that these were cases of lead poisoning. The cause on this occasion was most interesting : there was a small mill belonging to one of the farms which had been there for some decades. The upper of the two mill stones was not properly formed and did not perform its work satisfactorily, so a piece of the stone had been removed and the hole filled in with lead, in such a way that the lead did not reach the grinding surface, but lay in the mill stone like the filling of a tooth. That had been done years before and had proved quite satisfactory. But in time, part of the stone was filed away until finally the flour was no longer being ground between two harmless stones, but between stone on the one side and lead on the other, and that is what had caused the harm. Eleven of the twelve inhabitants of that particular farm fell ill, and of the seven inhabitants of the neighbouring farm five also suffered from lead poisoning (the neighbour's mill had not been working in the period immediately preceding the cases of illness and so he had ground his flour next door).

Upper Austria is rich in must (new wine) and this

has often caused not only alcoholic but lead poisoning. The pipe which leads the must from the press into the cellar-stored vats is often made of lead. This in itself would not matter as the freshly pressed grape-juice does not corrode the pipe. But some of the must remains sticking to any uneven surfaces in the pipe and especially in its bends ; it ferments, becomes vinegar and that dissolves the lead. This results in lead poisoning and doctors in Upper Austria have had to deal with many such cases. The surgeon, Brenner, in Linz, refrained from operating on thirty-two cases brought to him supposedly suffering from some surgical ailment such as appendicitis because he was able in time to diagnose lead poisoning.

The *Central Journal for Industrial Hygiene and the Prevention of Accidents* reports a rare case of lead poisoning. A man had displayed symptoms of lead poisoning for three years and nobody had been able to find its source. He was the only one of his family to suffer, so that poisoning by water containing lead and so forth seemed excluded. And yet it was water taken from a domestic well out of an old lead pipe which was the source. The man was the first person to drink of this water in the mornings ; it had then been standing overnight in the lead pipe, while the other members of the family, who came later, obtained much fresher water with only very little lead. A reason was also found for the non-appearance of the symptoms for three years. A wireless-set had been installed towards the end of the period ; this was earthed through the lead pipe, and though there was only a weak current it detached some of the lead, which then found its way to the water in greater quantities.

Noteworthy are further the cases of lead poisoning caused by a bullet left in the body. A bullet thus lodged, though otherwise possibly entirely harmless, may be dangerous because of the poisonous quality of the lead, though the effects may not be perceptible for years.

The metal which next to lead is the most frequent cause of severe poisoning is quicksilver (mercury).

When Margrave George of Brandenburg, full of alcohol, but still wanting more, found a bottle containing fluid quicksilver and drank it off, that did him no further harm. But if anyone has the misfortune to swallow part of a pastille containing the sublimate chloride of mercury he will die a very painful death. Here the mercury, that terrible poison, is not liquid, but in the form of an easily soluble salt which penetrates with equal ease into all the cells of the body, entirely destroying them. And anyone who has seen the fearful devastation which may be caused by both the chronic and the acute form of mercury poisoning finds it entirely comprehensible that war was waged for centuries against this medicament—in spite of the fact that in the hands of informed doctors it had shown itself most beneficial. Until a very short time ago it was the one remedy which—given in careful doses—aided many thousands of sufferers from syphilis.

The symptoms of mercury poisoning are truly terrible, especially in the acute form.

The first symptom is inflammation in the mouth. In the mildest cases the gums are swollen and bleed easily, the teeth are loosened and there is halitosis. In the more severe cases the mucous membrane becomes one mass of ulcers, and this as well as the tongue show

enormous swellings, so much so that the tongue has hardly room in the mouth. Saliva streams continually out of the mouth, several quarts daily. This is only part of the torment, the others affect the intestines and the kidneys : these organs are not seldom severely inflamed, with all the consequences of such inflammation. There may be other symptoms as well, such as inflammation of the nerves, paralysis, rashes on the skin. The painful inflammation of the mouth is also one of the symptoms of the chronic form of mercury poisoning. Such patients sometimes suffer also from sensory disturbances, from great excitement, supersensitiveness of the skin, or (in some skin areas) subsensitiveness. The muscles tremble and twitch.

Though Margrave George—and others—suffered no harm from their taste of mercury, in exceptional cases even the pure metal may be dangerous. And certainly harmful are the mercury vapours ; poisonings have often been noted in the few mines from which this metal (cinnabar) is obtained and the many works in which it is employed, such as mirror factories, also in chemical and technical laboratories, in dye works, hat factories, bronze workshops, and so on. A large number of factories belong here. Mercury vapours were also formerly used as a remedy for syphilis, and old medical textbooks have pictures of the large vats in which these cures were carried out.

Mercury compounded with grease forms the grey ointment which chemists are often asked for as a means of destroying vermin, and which—before the era of salvarsan—was the most widely used remedy in the treatment of syphilis. The applications of the ointment performed a number of cures, but also caused poisoning

when too much was used and the first warnings (inflammation of the gums) were not noted. Calomel, mercurous chloride, is often used in medicine, in small doses it is an excellent purgative ; in ophthalmology too calomel is sometimes used, but through the mistaken application of too large a dose many an accident has been caused.

The most important mercury preparation is the chloride, the sublimate, which since its power of destroying bacteria has been noted is used in very large quantities in hospitals and households. The pastilles made of the sublimate are coloured with eosin to prevent mistakes, but nevertheless many accidents have happened. Even in letting a solution of the sublimate trickle over a wound great care must be taken ; the proportion generally used is a solution of 1:5000, but if the surface of the wound is very large a great deal of the sublimate is thus absorbed and this has caused many a fatal case of poisoning. The sublimate is also used for injection in the treatment of lues. A number of other combinations of mercury are in existence. There are fanatical opponents of quicksilver as a remedy and an enormous controversy exists on the subject. In any case the sublimate pastilles should not be left lying around loose in any household, and the doctor must know that though the mercury preparation can do a great deal of good he must exercise extraordinary care in its application.

The number of crimes committed with preparations of mercury is very large. Benvenuto Cellini, the famous sculptor of the sixteenth century, relates that he was poisoned by quicksilver, and that he suffered from the consequences for a whole year. (This is

possibly true as he had many enemies.) In recent decades the Courts have often been concerned with poisoning committed by means of the sublimate, of calomel, of cyanide of mercury, and so on. Suicides by means, for example, of the sublimate, have been even more frequent.

Goethe, who was also interested in these questions, discovered in an epigram by the late-Roman poet Ausonius, the following story : A man fell ill because he had been given poison by his wife, but he did not die as quickly as she desired ; thereupon she gave him mercury and to her great astonishment he recovered his health completely. Goethe, therefore, enquired of Döbereiner, his constant adviser in chemical matters, what the poison could have been, against which quicksilver had proved such an effective antidote. Döbereiner was of opinion that it had been the sublimate, which had been reduced by the metallic quicksilver to the much less poisonous calomel. Whether this chemical process was carried on in the poor man's stomach, or whether the woman had given him both substances together remained unexplained. " For the chemist," Goethe remarks, " the question is unimportant, for the doctor it is of some significance."

A present-day problem in regard to quicksilver should be shortly mentioned. Obscure symptoms of illness sometimes occur, such as abnormal fatigue and lassitude, which cannot be covered by the general cloak of neurasthenia. The opponents of mercury have suggested that these and other conditions may have been induced by the (mercurial) amalgam fillings that so many people have in their teeth, and from which the mercury may find its way into the organism. Now

mercury is easily discovered, even when only present in very small quantities, by analysis of the excretions of the body, and by this chemical analysis mercury has actually been found in the case of persons with these amalgam fillings. On the other hand, the same result of the chemical analysis has been obtained in the case of persons who have no such fillings. Here then was a new riddle, but it was solved. Seed-corn is sometimes treated with a dressing containing quicksilver, the quicksilver finds its way into the corn and from here into the human body. But the quantities in these cases are so insignificant that they are of no practical importance, and are just as harmless as the amalgam fillings.

CHAPTER XX

SOPORIFICS

"Sleep is a periodically recurring incident in life with a peculiar loss of consciousness which serves the purpose of building up crescent vital energy and of rebuilding the vital energy already consumed." This is Professor Otto Marburg's definition of a phenomenon of normal healthy life, which as such need not be discussed, but which becomes a great problem in the case of individuals who are unable to find sleep to heal their tired bodies and their tired minds.

Since human beings have known physical pains and troubles of all kinds which disturbed or made their sleep impossible, they have sought for media with which to restore the lost function. Possibly the attraction of intoxication first arose out of a yearning for sleep, and in any case the advantages of a sleeping draught concocted from plants with great knowledge and care, have been known for thousands of years. We can only guess what was contained in those sleeping draughts taken by the ancients. Probably it was often opium, and it is known for certain that opium was in many cases given secretly. In mythology the poppy is always taken as a simile of sleep, and Somnus, the sleep patron of the Romans, bears a poppy-stalk in his hands.

The mysterious mandragora played a great part as a sleeping draught of the ancients; it was probably brought from Persia to Greece and from there penetrated into other countries. It is a solanaceous plant with a curious tap root, somewhat resembling the

human figure ; this probably contributed to its mystic reputation, especially in connection with the soporific effects of the yellowish red, pleasant-smelling fruits. It is known to-day that this plant is poisonous, as it contains the two strong poisons hyoscine and scopolamine, but thousands of years before these poisons were discovered by chemistry, people were aware of the effects of a drink containing juice from this plant. The importance of dosage was also understood in those early times ; a few drops brought a light slumber after the fatigues of the day—so and so much more induced a heavy sleep that no ill-wisher could disturb—and still a little more was followed by eternal sleep. Many of the ancients called a doctor and ordered him (the doctor in those days was often numbered among the slaves) to prepare a fatal sleeping-draught when they felt they were about to die or wished to do so.

It was not till later that such orders were frequently given to doctors for other criminal purposes. This is supposed to have taken place the first time in the fourth century B.C. when Dionysius, Tyrant of Syracuse, fell a victim to such an order. Cornelius Nepos relates how the son of Dionysius compelled his doctor to prepare for his sick father the deadly sleeping draught (almost certainly opium) in order that the father should be unable to make provision for his succession. Thus the son succeeded in the place of his uncle. Later, particularly in the decadent period of Roman culture, sleeping draught and poison-cup were often identical. The Middle Ages, too, made use of sleeping draughts ; in our own day the term " nightcap " covers several forms of sleep-inducing alcoholic draughts.

The existence of sleeping draughts in the modern

sense begins with the year 1832 when Justus von Liebig, Germany's greatest chemist, discovered chloral hydrate. Many pharmacologists to-day strongly disapprove of this medicament and Lewin calls it "the most dangerous of all soporifics which ought to have been discarded long ago." Nevertheless it must not be forgotten that the discovery of chloral hydrate was an epoch-making event of which German chemistry may well be proud, although Liebig at first did not know what benefits would accrue to persons suffering from sleeplessness by his discovery of chloral. It is true that chloral hydrate is no harmless sleeping draught, but at the time when it was introduced into medical practice—by Liebreich in 1869—the only available drugs for the purpose were opium and morphia, the subsidiary consequences of which were often much more serious than those of the chloral hydrate.

This is a colourless crystalline substance easily soluble in water and alcohol and causing inflammation when laid on the skin. Small doses are insufficient, but two—or at the most three—grams are sufficient to calm even very violent excitement and procure sleep. More, however, must not be given, otherwise the patient relapses into unconsciousness and the heart and respiratory organs are paralysed. From this it is clear that special care is needed in its application, particularly in the case of patients whose hearts, blood-vessels or lungs are strained either by their illness or even only by fever.

The fact that this medicament is a relatively strong poison has naturally caused many accidents, and that is why doctors distrust it, particularly as people exist who are peculiarly sensitive to poison and take harm even

from very small doses. The symptoms of poisoning vary. Generally it is the function of the heart which becomes alarmingly weak ; respiration also is affected, becomes superficial, may even cease temporarily, and cramps may ensue. Death occurs while the patient is in a state of deep unconsciousness in consequence of cardiac paralysis.

Chloral hydrate has also caused accidents through pure mistakes, though in general it is easily distinguishable by its sharp odour and pungent taste, at least in its crystalline form. Professor Strassmann mentions the following case : An elderly man one morning took by mistake instead of Carlsbad salts two teaspoons of chloral hydrate. A quarter of an hour later he was found by his family asleep with blue lips ; a doctor was called, who had him taken to hospital. There the patient died in the evening after a lavage of his stomach had twice been carried out. After the first lavage which was performed with sixteen quarts of water, the patient who had been unconscious, recovered a little ; he was able to give his name, but he soon relapsed into unconsciousness, his pulse became weak and his pupils contracted to dots. The second lavage with twenty quarts of water had no effect at all. (At the autopsy it was found impossible to discover traces of the poison, nor was the chemical analysis more successful.) Chloral addicts have been known to exist, though they are now rare, who have accustomed themselves to this drug in the same way as morphia addicts to morphia, and thus caused themselves severe physical and psychical disturbances.

Doctors, then, were soon dissatisfied with chloral hydrate and better sleeping draughts were sought for.

It is impossible to mention all the many kinds that have since been discovered. Paraldehyde, produced in the year 1883, a colourless liquid with a smell like ether was somewhat less poisonous. A larger quantity than in the case of chloral hydrate is needed before a dose becomes poisonous. On the other hand, it is less certain in the effect it is meant to produce, that is, as a sleeping draught, and headaches the next day are no rare thing. Also it created addicts some of whom are known to have consumed thirty or forty grams a day, that is an enormous quantity. All this detracted from its popularity. Nor did amylhydrate find many adherents ; chemically it is akin to ordinary alcohol, which can itself only be used to induce sleep in certain cases and often fails altogether.

Then came more recent drugs such as sulfonal, trional, dial, adalin, a large group which is continually being further developed, the most popular preparation of which is veronal, a di-ethyl barbiturate. Barbituric acid, the parent of veronal, is a product of urea and malonic acid and was discovered in the year 1903 by Fischer and Mering as a hypnotic ; since then it has remained the most important component of this division of pharmacology. It is, taken in small doses, an excellent sleep inducer and almost free from the subsidiary effects which make the remedies mentioned above so unpleasant. Of course here again people exist who cannot tolerate even the smallest dose and react to a single tablet by producing a nettle rash. Deaths from comparatively small doses have also occurred. This, however, is the case with all medicaments which are not entirely neutral, and so veronal is no worse than the others.

Veronal has also been used by many suicides, but murders by means of veronal are rare. The case of a cook is notable who put veronal into the food in order to send the whole family to sleep while she escaped with the silver. Even when very large doses of veronal are taken, death does not generally ensue until after two or three days. In the milder cases it is no rare thing to find a very irritating rash. Medical aid consists in applying artificial respiration, a stomach-pump, cardiac restoratives and, very recently, a solution of grape-sugar which is given drop by drop in an enema, or as injections ; it has been observed that this assists the organism to rid itself more quickly of the poison.

There are many other kinds of sleeping draught. For some of them the starting-point is urea, one of the final products of metabolism. This was the first product produced by living organisms to be synthetically copied by chemists in their laboratories ; it was Wöhler who made this great discovery in 1828. And it is comprehensible that there is such affinity, nay identity, between urea and sleep-producing drugs. One need only visualise the person who is very ill, whose kidneys refuse to function and no longer succeed in removing these waste products of bodily processes. The consequence is that well-known, very serious illness uremia, poisoning with urea accompanied by a deep unconsciousness. Nature itself, by means of one of its pathological processes, thus pointed out a way of producing sleep. That was how one came to find this group of sleeping draughts, to find barbituric acid and then a long series of others, such as urethan, hedonal, nirvanol, and so forth.

Both patients and doctors feel a great need of such

drugs, and though it may be argued against them that they are taken too often, even when it would be possible to do without them, that they are often abused, that they often cause harm, it must not be forgotten what a great comfort and blessing they can be to suffering mankind.

CHAPTER XXI

ARROW POISONS

Thousands of years before medicine discovered strychnine as a therapeutic medium in nux vomica seeds, the inhabitants of the East Indies were aware of their poisonous effects and dipped their arrows in the easily prepared poison-juice. Here as everywhere Nature pointed the way for men to find the weapons they sought for, driven by some incalculable instinct, long before science caught up with such discoveries.

The very oldest writers have mentioned poisoned arrows. Odysseus sought poison for his arrows in distant lands, Achilles was obviously the victim of a poisoned arrow. Phinius, in his world history, writes in painful indignation : " Who besides human beings dips weapons in poison ? We moisten our arrows with it and make the iron still more harmful. Except human beings no creature does battle with alien poison." Aristotle describes in detail the arrow poison of the Scythians, that famous nation of riders and archers in the Caucasus and on the Black Sea : " The poison is said to be derived from snakes ; they are caught and left for a few days until they decay, then human blood is put into a pot and also allowed to decompose, after which the watery liquid which forms on top is mixed with liquid from the vipers. That forms a deadly poison." Aristotle also relates of the Celts in western Europe that they used a poison for hunting purposes. This is confirmed by Phinius : " The Gauls when they

hunt make use of arrows dipped in hellebore. They cut out the flesh surrounding the wound from the game they thus bring down, and eat the rest of it." The deadly poison veratrine is contained in the root of the hellebore plant.

The history of arrow poisons acquaints us with various botanical products and with some of those of the animal world. The study of this subject is not easy. The mystery which surrounds all primitive peoples is here particularly impenetrable, and very probably the common members of the native tribes in Africa, Asia and South America who still to-day make use of arrow poisons in hunting and in war, with the help of blow-pipes or archery, are themselves unaware how the poison is obtained and prepared. This knowledge is probably confined to the chief or the medicine man who has every reason to keep his secret, only passing it on to the next generation. In some tribes it is forbidden to speak of these matters at all—it is taboo like all other mystical matters.

Strychnine, the product of nux vomica, has already been mentioned. Many plants belonging to this family can be used as arrow poisons. In the Dutch Indies the natives put an extract from nux vomica seeds into the furrows of their arrows. In Bornea, a variation of this tree is found, the fruits of which are rich in strychnine and also produce a serviceable arrow poison.

To the same family belongs the *icaja*, found on the west coast of Africa, which contains not strychnine but a similar poison *alazgin* which has a similar action to strychnine and causes tetanic spasms. The strong poison brucine, too, is used as arrow poison or, in other

words, those plants are used which contain this poison so similar to strychnine. In these cases the arrow poisons actually employed do not contain a uniform substance, but a mixture of several poisons : strychnine, brucine and other vegetable products, to which snake poison is often added. The natives on the Malay peninsula take fruits, roots and leaves of the plants they know to be useful for the purpose, add portions of snakes and scorpions, thus obtaining a poison extract which they concentrate still further by evaporation and then use dry or in the form of juice. The arrow poisons vary with the different tribes. Big game-hunting naturally demands other kinds of poisons from those used in hunting birds or fish, which wild tribes, as is well known, often secure by means of poison arrows.

The sources from which reliable information can be obtained regarding arrow poisons are not very numerous, but rather more is known about those used in Malay. The " Semangs," a branch of the " Orangs," concerning whom Paul Schebesta made a detailed report in 1928, used the upas tree as a poison source ; it belongs to the same family as the strychnine-producing plant, but its poison is not strychnine ; it acts more like curare or digitalis, of which more will be said later.

There is said to be yet another tree on the Malay Peninsula which affords an even stronger arrow poison. The Semais—the most beautiful type of men among the Malayans—have the reputation of being specialists in the preparation of poisons, to whom other tribes apply for their supplies, offering other wares in exchange.

The way the poison is prepared is very interesting. Schebesta describes it as follows :

"Iron pans are used for boiling and preparing the arrow poison. Like the rest of the native tribes the Semai use the blow-pipe as a hunting-weapon. The poison is similarly extracted from the upas tree, but I have heard that there is another kind of poison sometimes employed, much stronger still than the poison from the upas. The people in Batang-Padang assert that the Semai of Bertak understand how to prepare it; the latter, however, denied this and named the people of Jelai as the producers—they themselves, they said, understood nothing at all of the preparation of poisons, as the upas tree did not grow in their district. Cerutti, on the other hand, alleges that the Sakai of Bertak are the most cunning poison-preparers of any, and that all the Sakai turn to them when they wish to procure poisons, as theirs are extraordinarily effective.

"As the method of preparation is unusual I think it advisable to describe it. First of all a sufficient quantity of the legop (a creeper) is collected, a plant known to contain poison. Next come two tuberous plants which contain a sticky liquid. Two kinds of wasps, one black, the other red, whose sting is particularly painful, are caught and then a search is made for a poisonous snake and its fangs extracted. The legop roots are crushed into a pulp with which a piece of bamboo is then filled, the opening being closed with leaves so that the liquid can trickle out. The filtered mass is boiled and the slimy tubers squeezed out over it. Then the wasps and the poison fangs are crushed into the pulpy mass and the dirty foam is removed from the slimy reddish concoction, which continues to simmer gently after a little water has been added to it. The poison mixer is careful not to inhale any of the vapour, as this is injurious. On the day that he carries out this process he is not allowed to

eat fish or meat and has to fast until the poison is ready. Although he washes himself thoroughly after his work he is looked on as a sick man for several days.

" The pot or the piece of bamboo used for boiling the poison must be completely new and may never again be used for any other purpose. Contradicting this, I was told that the pan used for boiling the poison may not be used for ten days, must be thoroughly well washed every day and may then again be used for the preparation of food.

" Women are not allowed to look on when poison is being prepared, as an evil spirit which supplies the poison with its potency would harm them. The Sakai of Batang-Padang related that women are forbidden to eat of the animals which have been killed by poison, while the meat, when the flesh around the wound has been cut out, does not harm the men."

Lewin too, describes the upas tree and refers to reports made in the eighteenth century. The upas tree, the poison tree, is one of the wonders of this part of Asia. Fables of all kinds are told about it. It is a very tall tree, with a smooth trunk, often bare up to a height of twenty yards where the lowest branches begin. The branches are covered with bracken, the foliage has a round crown—there is nothing really characteristic in its appearance. The inhabitants make superficial cuts in the bark and fasten a palm leaf underneath the incision to catch the sap flowing out of it. The first day the tree yields ninety grams of sap, after two days five times as much. One poison arrow takes nearly one gram.

Lewin examined a small quantity of the hardened gum, which was contained in a cane stopped up with tobacco leaves, and ascertained that the poison had lost nothing of its potency in four years. The scientific

name of this tree is the *Antiaris toxicaria*, and the actuating principle in the poison is called antiarine. One thousandth of a gram will kill a dog in a few minutes through paralysis of the heart.

As already mentioned the natives used and still use different poisons for different purposes, the stronger poisons contain more " upas " poison, the milder more strychnine and brucine. Even the weaker poison mixtures are strong enough to kill a tiger (with one arrow) in from twenty to twenty-five minutes. Morgan mentions that a monkey hit by a poison arrow at once drew it out of the wound ; a tiny fragment of the point, however, remained in the wound and sufficed to kill it within two minutes. Whether it is true that the fresh sap from the tree is harmless and only becomes poisonous when it has gone dry is a question in dispute, although Stevens experimented on himself. Thirty drops did him no harm.

The most interesting poison of all is curare, the poison of the American Indians. Sir Walter Raleigh —towards the end of the sixteenth century—brought home with him an arrow-poison obtained from the Indians, which was known under the name of ourari. The Spanish conquerors of South America also made its acquaintance and learnt to fear it. Contemporary reports relate how the Spaniards tortured the South American Indians in order to make them disclose what antidotes they possessed against their terrible arrow poison. How many suffered from this question-torture is not known—the South American Indians possessed no antidote against curare. There is none.

Interest in this poison has continued. It is a strange poison, which kills by inducing paralysis,

apparently without causing any pain. Alexander v. Humboldt was the first to give an authentic account of it ; he was present in Esmeralda when a lianas (tropical creeper) was boiled down to a thick sap, after some other plants had been added. This concoction contained, he was told, the arrow-poison of the Indians.

It then proved easy enough to identify the plants. They are certain varieties of Strychnos, and the curare is obtained from their bark and wood. In Guiana, Brazil and Peru, on the Amazon, the Orinoco and the Rio Negro, and probably also in other parts of South America, the nativesare acquainted with the trees and shrubs from which arrow poison can be obtained, and centuries ago the knowledge penetrated into North America. And, further, the trade between the various Indian tribes of South America brings curare into the districts in which the parent plants do not grow. There are different ways of packing it—in bamboo, in pots, or in sacks. The colour of the dried substance is yellow-brown to black.

It possesses the property of paralysing the nerve-ends in the muscles. Physiologists, therefore, have long been accustomed to use curare for experiments. Ernst Brücke in his lectures (1874) reports : " When the muscles of a freshly killed animal are pinched, pulled or when a probe is passed across them with considerable force they are observed to contract. It was formerly believed that this was only because the nerves had been stimulated. Now, however, an Indian arrow poison—curare—has enabled us to poison the nerves within the muscles, so that they can no longer be stimulated, thus leaving us to deal with muscular tissues alone. It is found that muscles thus poisoned with curare are not

only not insensitive, but that they are highly susceptible to mechanical stimulation. The same is true of chemical stimulation, etc."

More recently—in 1921—Graff, who spent several years with the head-hunters on the Upper Amazon, published a report. The weapons of these people are blow-pipes and poison arrows. The poison is called "jambi" and is an extract from lianas bark, which, as Graff reports, has a rapid and painless effect on all the animals and birds in the woods with the exception of the jaguar. Graff himself once drove a jaguar up a tree and shot it several times with poisoned arrows without achieving any effect. Graff makes no further communications with regard to the poison itself. The arrows are made of bamboo, one end of which is sharpened to a point, dipped in jambi and dried in the sun or at a fire.

The lianas creeper is to be found everywhere on the Upper Amazon. First its principal bark is taken off, then the inner lining of the bark is scraped into flakes, boiled and passed through a sieve. The juice is then boiled again into a thick brown liquid which becomes semi-rigid when cold. The preparation is accompanied by a great deal of ceremonial. Other substances are added, such as the stings of insects, spiders' teeth and so on. The pot too, in which the bark is boiled is made to the accompaniment of a number of prescribed rites. The Antipas, the Indian race inhabiting that district, call their lianas barbasco, and they use their poison, which is certainly identical with curare, for catching fish. For this purpose they hammer the barbasco-wood with heavy stones and then throw the pieces into the bay they have chosen for their

fishing. After a few minutes the fish rise to the surface in a stupefied condition and can easily be taken out of the water. The Indians also use this wood for committing suicide, but not for war. Their principal hunting weapons are the arrows saturated with the poison ; these are so made as to be extraordinarily effective. At a range of fifteen yards they can pierce a board a good half-inch thick. They are, for example, much better suited for hunting monkeys than bullets, principally because here death literally flies through the air without giving the slightest warning sound or stampeding other animals ; the monkey that has been hit falls from the tree to the ground without making a sound and is dead two minutes later, while when monkeys are hunted with guns each specimen has to be shot to pieces.

The poison arrows are sent by the Indians through blow-pipes, an instrument well adapted for the purpose. The blow-pipes, which are used by many tribes, are about three yards long and provided with a mouthpiece. The mouthpiece is made to fit each individual user. The arrows can carry about sixty yards.

Curare is the proper poison for arrows ; it belongs to that order of poisons which is not nearly so deadly when taken through the mouth as when it is injected subcutaneously or directly into a vein. Even an ox dies about twenty minutes after it has been shot by two or three arrows tipped with curare. With smaller animals death comes even more quickly. Not as much as one hundred-thousandth of a gram—i.e. so minute a quantity that it is almost inconceivable—is necessary to produce in a frog that condition of paralysis which the physiologists describe. All the muscular fibres are

paralysed, all voluntary movement and all reflex action has ceased, there is nothing to show whether the animal can still feel, whether it suffers.

The heart continues its work longest, it goes on beating even after the respiratory muscles have been paralysed and death has ensued. Thus artificial respiration is the first remedy to be applied to any one poisoned by curare. The whole animal world must respect this poison. The only (comparative) exception is the sloth which is able to defend itself for some time, though not permanently against the poison. If the dose is large enough even this animal succumbs.

Medicine has no longer any use for curare, even forensic medicine has very little opportunity of dealing with it. In the trial for poisoning of Dr. Riedel, a Swiss doctor of medicine, held in the year 1931 in Burgdorf, curare was mentioned. The prisoner wanted to procure some in order to remove the warders and make his escape. The whole affair was, however, more mysterious than important.

A great catastrophe was just averted in Vienna in May, 1932. Burglars who had broken into a chemist's shop obtained possession not only of cocaine, morphia and other drugs, but also of some curare which by some chance was kept in the poison cupboard and had probably been there for decades. The burglars were sought for and found among the illicit purveyors of cocaine, and the poisons, including the curare, were seized before any harm had been caused by them.

While strychnine is used to a certain extent in medicine and curare not at all, another arrow poison plays a great part in therapeutics. This is the poison obtained from the strophanthus plant, an excellent

cardiac drug. It was recommended by Fraser in 1885 in the place of digitalis, and though strophanthus has not succeeded in replacing that sovereign cardiac remedy entirely, it must be named with it among the medicaments which have a good influence on the heart.

When Livingstone reported on his Zambesi expedition, his report contained a passage in which he mentioned a poison found by Lake Nyassa of which it was said that it was used exclusively for killing human beings. It was conveyed on little wooden arrow-heads and protected by a maize-leaf. His companion Kirk then discovered by chance that it retarded the action of the heart. Livingstone mentions this in his book.

The strophanthus plant is a creeper which climbs up very high trees and spreads itself from one tree across to others. It is a true product of African forests. The poison is contained in the seeds ; around Lake Nyassa it is called " kombé." Strophanthus seeds are also used as arrow poison in Gaboon in Equatorial Africa. The same is said of the negroes in Senegambia, of the natives in the interior of Togoland, and it may be assumed that other African tribes use the same poison, which is very plentiful there.

Other tribes again use other arrow poisons. The Abongos on the reaches of the Ogoway use an arrow poison which belongs to the digitalis group. Lewin investigated these arrows. A rabbit which had been injected with about one five-hundredth of a gram of this poison, died after about a quarter of an hour, but its heart continued to beat regularly some time after death had set in. West of Lake Tanganyika live the Wabuwo whose poison is so greatly dreaded that robber tribes do not dare to attack their territory. The poison seems to consist, as experiments on animals

have shown, of two very potent poisons, one of which, probably belonging to the digitalis group, affects the heart, the other acting to paralyse brain and spinal cord.

The forest Bantu in the Congo territory use the milky sap of a tree. The Wakambi (near the Kilimanjaro), the Walaiti, Somali and others choose as their poison source a tree belonging to the family of apocynaceæ. The poisonous principle of these trees and plants is called " quabain " or " onobain." Experiments with animals have shown the great potency of this poison, particularly on respiration. Creaking breath, air starvation are the symptoms, and the animals die after suffering cramps and relapsing into unconsciousness.

Some animals of the woods and plains are provided with poison-bearing organs, and such products are also used by wild tribes for their arrows. Sometimes the venom is culled from snake-glands, as in the case of the Kalahari Bushmen, sometimes from poisonous spiders, or, also in the case of the Bushmen, the poison contained in the pupa of an underground beetle (placed as being the diamphidia simplex Beringuey) is taken. Animal experiments have shown that the cocoons, larvæ and the beetles actually are poisonous.

There are many other kinds of arrow poison ; much that is interesting still remains hidden, possibly some secrets that might be of great value in medicine. It is not certain that these mysteries will ever be unravelled. The only thing that is certain is that even the members of wild native tribes are now nearly all aware that a gun is more effective than a blow-pipe or bow, and that they are quite ready to throw their implements away if they can obtain guns—the more modern the gun is, the more gadgets it has, the better they appreciate it !

CHAPTER XXII

POISONOUS ANIMALS

We are told that Cleopatra killed herself with the help of an asp. " Cleopatra laid an asp on herself and was killed by its poison." Fantastic as this seems to us, it is apparently an historical fact, probably at the time not even a particularly sensational one. Suicides were far more common than they were later, and poisonous asps were plentiful. This episode made the asp—a poisonous snake over two yards long—famous, but it is only one of many kinds of poison snakes.

There are in existence about 2300 varieties of snakes, and it was once ascertained that about one-tenth of them are poisonous. Gradually, however, more and more kinds are being discovered to be poisonous and it is not impossible that all of them may be found to produce some kind of poison, though not always a kind capable of harming human beings. In the ordinary way snakes are placed in the poisonous or non-poisonous category according as they are poisonous to human beings or not. Most of the former are to be found in tropical countries. Many of them are well known. There is India's hooded snake, the dreaded cobra, feared, respected and even reverenced, as it is bound up with Buddhistic tradition. No Hindu would kill one, although he knows how dangerous it may be to his own household. Very much larger than the cobra is the giant cobra, which can be four and a half yards long and is one of the most dreaded serpents

of Asia. In Africa are found, besides the asp, the large mamba snakes, venomous tree-snakes. These are all elapidæ, as are the death (or black) adders found in Australia, the flesh of which is eaten by the natives, the coral-snake of South America—which is not longer than about half a yard—the magnificently coloured harlequin snake and many others.

The family of vipers (Viperidæ) is particularly large and is represented in our latitudes by the common viper or adder (*Vipera* or *Pelias berus*). Its natural history is known to most people. Its colour is often grey, but the colouring varies ; it has characteristic markings, is about three-quarters of a yard in length, can be found in fields, in meadows and in caves and its head is always broader than its neck. During the day it seeks a place in the sun where it is not too exposed, at night it forages for mice. It lays eggs, out of which the young are immediately hatched, from the first provided with the same weapons and having the same qualities as the parents. They hiss, they bite, they are venomous and at once provide for their own needs.

Then there is the viper which is the poison snake of the countries on the Mediterranean, of Southern Europe. Seventeenth-century scholars discovered that in these it is not the gall, but a poison fang which contains the deadly matter. Strangely enough a scientific dispute raged on this question, though the Ancients—long before Cleopatra's time—had registered their experiences in the matter.

Related to this is the Sand Adder, much dreaded in the Balkans and other southern districts. In the Caucasus too very dangerous vipers are to be found—the Kaznakow viper, for instance, the bite of which—

so Voronoff reports—is capable of killing a bull. The "Gürsa" is considered still more venomous; it is a somewhat larger viper, found also in Northern Africa. The chain-snake, one of the longest representatives of the family of vipers—it is a yard and three-quarters long—lives and causes havoc in India, and probably Brehm is right when he says of this that it "plays a greater part among the unrecognised serpents which take their large annual toll of human beings than is commonly believed, as, like other venomous snakes, it is no rare thing for it to find its way into dwelling-places, where it will even lie down to sleep towards morning." This, of course, does not mean that it is particularly bold in its pursuit of human beings. It only attacks when it believes itself to be threatened. This is the case with most venomous snakes—their poison fang serves them for the purpose of defence and for obtaining food.

The horned viper is found in Africa very frequently. The ancient Egyptians called it "Fi," and its sign—an F—is to be found in hieroglyphics. It is the snake of the Desert Sahara and its colour is approximated to that of the sand. When danger threatens it, it disappears in the sand within a few seconds. Konrad Gesner, the famous Swiss naturalist of the sixteenth century, has much to say of the sand viper; for instance, that the negroes of the Phyle tribe, who were particularly well acquainted with the ways of this snake, tested the virtue of their wives by laying their new-born children next to a sand viper—if it was a legitimate child of the Phyles it would remain unharmed.

Then there are the pit vipers, a subsidiary branch of the viper family with similar peculiarities. They acquired this designation through being "pitted," that

is, through having a deep pit or canal between the nose and the eye. They are much better known as rattlesnakes. The *crotalus horridus* is the rattlesnake proper, which has taken the name really applicable to the whole family. It is truly horrible and dreaded by man and beast in the whole of western North America. The pig is the only animal which dares to cope with it. It is about a yard and a half in length. Its " rattle " consists of several horny rings mounted over one another. If the snake is tantalised it rises, lifts its tail, moves it backwards and forwards, thus producing the characteristic rattle which announces its fearful presence. There are sixty known varieties of the rattlesnake, which holds an important position among venomous snakes, both on account of quality and quantity.

The venom is produced in snakes by twin glands, such as the salivary glands, situated in the creature's head. The substance produced by the glands is brought into play by means of the poison fang. This, then, is the essential organ. Either it has a narrow duct like that of a hypodermic syringe—the common viper is an example—or only a furrow along which the venom penetrates into the body of the enemy. The cobra has this latter mechanism. It is, as is well-known, possible to render a poisonous snake harmless by extracting the poison fang, but it should be remembered that this organ grows again. Snake poison has, of course, been carefully investigated by toxicologists and chemists. In order to obtain it the snake is induced to bite a piece of cotton-wool. The different varieties produce varying quantities of the venom—food, captivity, climate are factors which affect this.

In the case of some snakes their bite is followed

by a violent local reaction—the leg, for example, swells up and may become gangrenous. In other cases of snake-bite, the local reaction may be trifling, the general symptoms on the other hand very serious, death ensuing through paralysis of the lungs or the heart. Viper venom acts principally on the blood—it dissolves the red blood-corpuscles.

Like human beings, most animals are very sensitive to snake poison. But there are exceptions ; some animals are immune, others derive positive pleasure from a fight with a poison snake. The greatest enemy of the snake is the mongoose, which has even been imported from India to America in order that it may carry out domestic duties as a protector against snakes. The mongoose is a ferret-like mammal, its battles with venomous snakes have often been observed and described. The African secretary-bird, a bird of prey, is another great snake-catcher. Then there are non-venomous snakes which set about the venomous varieties and feed on them. In our latitudes the hedgehog is known to be immune and when it seizes on a common viper, the latter becomes a victim of the hedgehog's teeth.

Not in our latitudes, but in tropical countries, snakes are a great problem. In India even nowadays hundreds of persons die daily from snake-bite. In Sao Paolo in Brazil there is an Institute for snake serum, and here poison snakes are delivered, at the rate of about a thousand a month. Serum now plays the greatest part in the treatment of snake-bite, but it is not always to be had, and where it is lacking the old method of cauterisation must be employed. A good method is also to strew the wound with permanganate of potash.

Walter Burkart gives an interesting account of the treatment of a case of snake-bite in North America :

"A man returned one day from a hunting expedition in a very serious condition. He had been bitten in the foot by a rattlesnake. The laborious return on foot, which had taken three hours, had assisted the progress of the poisoning, and the leg was very much swollen all the way up. Nevertheless he refused treatment, saying that he was already cured. His companion, who had killed the snake, had told him that the bite would not harm him if he ate the creature's liver. They had looked for the liver, but in their agitation had failed to find it. He had, therefore, swallowed the whole of the entrails and felt quite safe in spite of the terrible condition he was in. I had to use a great deal of persuasion in reasoning him out of his superstition. In order to soften the pain of the operation I bound up his thigh tightly and then made several deep injections of a solution of one per cent permanganate of potash around the wound, above and below the knee. Then he had to take ten drops of spirits of ammonia every quarter of an hour until the swelling began to go down. For a time the foot remained paralysed, but the paralysis then disappeared completely. Later, however, his sight became permanently affected. If no other remedies are available when a person has been bitten by a snake, the old hunting method is the only one that helps ; it is safer than cutting and sucking out the wound. Immediately after the bite, the powder from a cartridge should be emptied on to the wound and set alight. The little fire-devil burns down deeply into the wound and destroys the poison."

Nowadays the serum treatment of snake-bite, which, when applied in time is the simplest and best remedy, is the one that arouses the most interest. Primitive peoples, by the way, have evolved a kind of precautionary vaccination against snake venom. Dr. F. W. Freise, in the *Calendar for Germans in Brazil*, says :

> " It may interest my readers to hear how the Indians of the frontier hills between Minas and Espirito Santo manage to forestall and render impotent the poisonous effect of snake-bites by a kind of vaccination. They catch a snake alive, irritate it while someone holds it and then let it bite into a lump made of different kinds of herbs. This package of herbs containing snake-venom is then squeezed out (the act being accompanied by a good deal of ceremonial), whereby a very small quantity of a yellowish fluid is obtained. With the help of a knife made of bamboo a certain quantity of this liquid is introduced into the veins on the back of the hand of the person to be " vaccinated." The operation, which I myself saw being carried out on several occasions, is followed by a state of delirium lasting up to forty-eight hours, during which the patient is kept wrapped up in rugs. When he recovers consciousness he immediately bathes in the river, drinks a concoction made of " tomba " and two fingers of spirit and looks on himself as immune."

There is, as already mentioned, a famous Serum Institute in Sao Paolo, and the Viennese Professor, Dr. Rudolf Kraus, has accomplished excellent work there. The poison is obtained from the snakes in the way already described, then injected into horses, in whose blood the antitoxins are then produced. Another excellent institution is the Pasteur Institute in Lille,

where Calmette worked out a particular method of producing snake serum. In our day Cleopatra might have been rescued.

Though snakes are the poison animals *par excellence*, there are others. Beginning with the lowest animals we have—after the bacteria which represent a transition from vegetable to animal and whose role as poison-bearers and originators of disease is known to everybody—in the first place very low-grade parasites, the most noteworthy of which are those to which we owe malaria and dysentery. Much higher in the scale are the nematophoran and the acaleph or sea-nettle (jelly-fish), and some others, provided with a poison which protects them and produces nettle-rash in human beings. They are a very interesting chapter in natural history. Sponge-fishers are particularly plagued by them. It is said that murders have been committed on the Antilles, for which dried sea-nettles provided the poison. Secretions produced by the sea-urchin are very poisonous to many animals.

Worms are of importance to human beings, as they not only cause local discomfort, but can by their excretions poison the alien organism. Symptoms of such poisoning are fever, vomiting, itching—and lastly anæmia, which may be so considerable as to endanger life. The most notorious of these worms is the ankylostomum, a round-worm which causes havoc among mine-workers even in Europe—mainly in southern latitudes, but also in Central Europe. It is a small parasite, about one centimetre long, which may reside in the small intestine of human beings, producing very severe, often fatal anæmia and other symptoms, which are certainly not caused only by the loss of the blood

on which the parasite feeds, but above all by the poison which its excretions introduce into the body of its host. This worm disease may take on epidemic form when many persons are congregated in insanitary surroundings, thus in mines, tunnel works and so on. Much attention is now paid to this danger. It is particularly great in exotic districts, and in Ceylon it can claim more victims than cholera.

Other species of worms too change the composition of the blood and they, or rather their excretions, must be placed in the category of blood poisons. Decrease in the number of red blood-corpuscles, lowering of the hæmoglobin percentage, the appearance of degenerate forms of both red and white corpuscles make up a blood-picture identical with that of pernicious anæmia. The severity of the illness caused is not dependent on the number of these parasites present in the human body affected. This observation applies also to the tape-worm, which is sometimes found in human beings and in many animals. Though the cause of the poisoning is said, as stated, to be the excretions, some investigators believe that poisoning does not take place until the worm dies and the products of its decaying body are absorbed by the " host's " organism.

In the tropics, people and animals are plagued far more often by such parasites than in our latitudes. Bilharziasis is produced by a worm that settles in the blood-vessels. There are various forms of this illness ; there is a bilharziasis which attacks the veins of the liver, another which settles in the bladder, and one is known in Eastern Asia which induces swelling of the spleen and the liver. All forms are combined with symptoms of general poisoning. In our latitudes an

occasional case of illness from the echinococcus occurs. This is a bladder-worm which reaches human beings via dogs, the brood of the worm settling in the liver, the brain or elsewhere—in bladders or capsules—and causing severe disorders which are not always easy to diagnose. The liquid contained in the bladders is also poisonous. A few cubic centimetres of it may kill a rabbit within a few minutes.

The molluscs belong to a much higher grade of animal life. Many of them have the reputation of being poisonous, but this may not be deserved. We hear most frequently of poisoning from oysters, and then that the sea-mussel has caused illness. Oysters are of course eaten raw, while the mussel is cooked. The mild form of such poisoning is a slight nettle-rash, the severe form is characterised by cholera-like symptoms and paralysis. Since a case of mass poisoning by mussels occurred in Wilhemshaven in 1885 the sea-mussel has been carefully investigated. Probably it becomes diseased and then poisonous when it has been living in stagnant water—as the oyster does when it has been kept out of water altogether. In such cases these animals are very susceptible to infection by bacteria, which spell the real danger to human beings.

Scorpions have always been one of the calamities of mankind. "Animals and humans suffer from this poisonous creature," wrote Professor Lewin. And Professor Pawlowsky, one of the foremost experts in this field, says the same thing: "Scorpions are a classical example of poisonous animals and have always been known to Man." They belong to the large family of arachnida. The narrow tail broadens out near its end into a hard ampulla, like a little vessel containing

poison, through which a sting is passed into the body of its opponent. Paired poison glands feed the sting.

There are about five hundred varieties of scorpion and they are found in a great many different places, mostly in hot or at least in warm countries. They are active at night-time, and often penetrate into human dwellings, so that in the tropics it is advisable to look inside one's shoes before putting them on. When attacking, the scorpion brings its sting forward in a curve, buries it in the body of its opponent and then releases the poison, holding its victim by its long chelicerae (fangs). The victims are mainly insects—spiders and wood-lice, but even the venomous tarantula succumbs. On the other hand many lizards, snakes and monkeys make meals of scorpions and they have a very dangerous enemy in their own camp ; the female almost always consumes the male after copulation. The female produces living young, which is at first helpless and remains for a time on the mother's back for protection.

The poison from scorpions has been intensively studied and the results reported. The tarantula succumbs immediately ; many butterflies, beetles and crickets are just as sensitive, also birds. A sparrow becomes paralysed after being stung by a scorpion and dies within a few minutes. The symptoms are reminiscent of the effects of the arrow-poison curare. Mammals too are susceptible to the poison—Aristotle mentions that pigs may be killed by scorpions. As regards human beings it has been said that in the tropics children sometimes die of scorpion stings, which seems credible in so far as experiments with animals may be taken as indications.

The usual consequences of scorpion stings in the case of adults are nausea and vomiting, fainting, convulsions, then more or less local phenomena according to the part of the body that has been stung. In medical literature we find some cases reported of adults who have died from this cause. The inhabitants of Algiers greatly dread the sting of a scorpion. The treatment of persons who have been stung is similar to that employed in the case of snake-bite. There are various institutes in the tropics which prepare a serum against the stings of scorpions, showing that great importance is attached to them there.

The best-known of the poisonous spiders is the already-mentioned tarantula. But there are many others the sting from which causes not only local reaction—which one would expect—but also symptoms of general poisoning. The same applies to ticks, bugs, fleas, centipedes, lice, and other creatures in this category. The poison of these creatures is produced in the salivary glands and is transferred to the body of the victim by a bite or sting. In this respect too the sufferings of the inhabitants of the tropics are far greater than those of Central Europeans. In South America, for example, a bug—a water-insect—occurs which is about three and a half inches in length and is so poisonous that it is capable of killing small fishes. Most bugs—though this is not commonly known—are plant-eaters, that is, their food consists of plant juices.

A few words should also be devoted to the venomous qualities of another set of two-winged creatures—to gnats, horse-flies and the house-fly. Some gnats (or mosquitoes) merely sting, others are so poisonous that they induce a rash which may last for weeks, some

convey diseases such as malaria and Papataci fever (also known as Phlebotomus fever). In the case of the flying insect (sandfly or phlebotomus) which carries the latter disease it is only the females which suck blood and transfer the disease by means of their saliva. Much dreaded by animals is the black crawler-mosquito which often appears in the neighbourhood of the Lower Danube in great swarms and torments the herds of cattle and the pigs, besides endangering them. The poisoning suffered by the animals from these creatures is very severe and sometimes fatal. The symptoms are want of breath and rapid pulse. The wounds made by these mosquitoes on human flesh take a long time to heal.

The largest two-winged insect occurring in Europe, namely the horse-fly, causes, in the summer months, a great deal of torment to human beings, horses, cattle ; strangely enough dogs and sheep are not attacked by them. They have a very strong proboscis which inflicts a wound into which the poison trickles ; here again the poison is produced in the salivary glands, but this is not so dangerous as the bacteria, pus-inducing micro-organisms or other poisons, which are casually transferred by these stings. The same applies to the house-fly, though here the sting is not nearly so painful as that of the horse-fly. That the African tsetse fly is the carrier of sleeping-sickness is sufficiently well known.

Caterpillars and their hairs can cause severe inflammation. Women whose occupation consists of unravelling the silk threads from the cocoons of the silkworm (or silk larva or caterpillar) often suffer from this. There are caterpillars which are avoided by

most birds and are so much dreaded by game that it will sooner forsake its own woods than stay in company, for example, with the processionary caterpillar. Only the cuckoo is not afraid of it and eats it entirely, including the hair. The hair of caterpillars is very dangerous for the eyes. When it has emerged from the larval stage the Spanish fly also represents a danger to human health. It is a golden-green beetle, about a quarter of an inch in length, the blood of which contains cantharidine, a blistering poison which causes violent inflammation. One ten-thousandth of a gram placed on the skin produces a blister on the spot, and that is why Spanish fly used to be employed as the principal ingredient of "blisters," formerly used as plasters in medicine. In how many cases such applications were followed, not only by the irritation of the skin which had been intended, but also by an entirely undesired inflammation of the kidneys, very severe illness and sometimes death, cannot even be conjectured. This effect on the kidneys is the reason of the reputation the Spanish fly enjoyed in the Middle Ages and later as an ingredient in love potions; it was supposed to engender love and many people must have been harmed by it.

Bees' stings are not only painful, but also poisonous. A sparrow, which is altogether very sensitive to poisons, dies after two or three stings from bees. It is easy to obtain bees' poison. If the belly of a bee is carefully pressed, a drop of clear liquid is exuded and this is its poison; it has a strong capability of resistance against cold and heat. Another insect, which also has a poisonous sting and which attacks bees, is of great interest. This is a species of wasp with the character-

istic name bee-wolf. Battles are waged between these two types of insects, each of which is provided with a poison weapon. The wasp is usually victorious in the duel ; it is much more agile and generally manages to place its sting in the bee's head. Then it squeezes the body of its dead enemy till the honey appears which it quickly swallows. The bee's corpse is then carried to the nest for food.

Xenophon relates in the " Anabasis " that the Greek armies once found a large quantity of honey, ate of it and fell very ill. And poisonous honey does actually exist. The honey gathered from particular plants at certain seasons is said to be poisonous, such as that from rhododendrons and azaleas. Some apiarists, however, are of the opinion that it is not the plants which are responsible for the poison content of the honey, but that it is the poison of the bee itself which has found its way into it. This is an interesting little chapter in the wide field of poisons which has not yet been adequately explained by scientists.

Some fishes too have poison glands and poison stings. For example the sting-rays, bony fishes of the order of *scorpænidæ*. These are the vipers of the sea. Many inhabitants of the South Sea Islands have been killed by them and the natives dread them greatly. In the Mediterranean and northern seas there is a weever (or sting-fish) which can also endanger human beings by its poisonous qualities. Its flesh, however, has a pleasant taste and is not harmful. The little sticklebacks, well known as nest-builders, also have poison stings, while the genus *Muræna*, very large sea-eels, in which the ancient Romans were much interested, have teeth which are provided with poison

produced from the palatal glands. There are many fish which, though they have no special poison apparatus, engender poisoning if certain parts of them, such as their liver or roes, are eaten. Such fish are the Japanese furube, the Fugu fish and some barbels. Among toads, frogs and salamanders there are many which are capable of spraying poisonous juices; probably they all can. A dog which brings away a salamander may be overcome by such symptoms of poisoning as convulsions, vomiting, fever and cessation of the heart beat.

There are many other animals which are poisonous, at least for beings of another race. Men's poison, as between one race and another and consisting of their words and their actions, has nothing to do with biology.

CHAPTER XXIII

BACTERIA

In the history of medicine one very sad incident must always find a place. On 6th February, 1932, a bacteriologist of international reputation—Professor Deycke—was sentenced to two years' imprisonment "for manslaughter." This was the final event of that great catastrophe which cost many children their lives in Lübeck. Nobody would wish to discuss the question whether the Lübeck judges, who had spent four months on the case, acted justly or too severely; in any case they had delved very deep into a subject which even the experts found puzzling and laborious. The trial, however, is notable, not only as having revealed a tragic example of human error, but also as an historical crisis in the battle waged for decades by human beings against the invisible enemies, that is, bacteria and their poisons.

The story of this battle takes us back to Robert Koch. In the year 1882 he succeeded in discovering the tuberculosis bacillus. Then came his first unhappy attempts to fight or, as he even hoped, to destroy the disease by means of his tuberculin. But the history of tuberculin embraces more than an account of his defeated hopes, of the hopes entertained by the whole world.

We know what the sad fate of those people was who were injected with tuberculin during the first years of Koch's experiments. Ignorance of the limits and methods of its application led to terrible consequences, and a great deal of reconstructive

study was necessary before the good and workable idea underlying the mass of errors could be disinterred and the rules discovered which, when followed, enabled the method to be used profitably. Tuberculin, as Koch produced it, is made from cultures of tuberculosis bacilli which are then killed, boiled and filtered, so that the actual tuberculin contains no more bacilli, but only their poisons. The dose with which the treatment begins must be exceedingly small; moreover, many tuberculous patients, for example those who are feverish or inclined to hæmorrhages, cannot tolerate it at all.

At first none of these facts was known or else Robert Koch's warnings were disregarded, and so the first disasters happened. Since then very many varieties of tuberculin have been prepared, each of them with its supporters who can point to successes. Besides the "old-tuberculin" there is a "new-tuberculin," an emulsion made from the dried and ground powder of tuberculosis bacilli, there is the Friedmann remedy which makes use of living tuberculosis bacilli obtained from tortoises; then there is the Calmette method, in which the original substance is a tuberculosis bacillus obtained from cattle; this is then diluted to a point where it is still capable of affording cattle protection from the disease, but is not strong enough to infect them. This was the preparation with which the children in Lübeck were to have been "fed," that is inoculated, and with which they were "fed" till on 17th April, 1930, the first death occurred. On 26th April Deycke stopped the inoculations, but it was too late, an unhappy error had already caused the catastrophe.

For the purposes of our present study it is a matter of indifference whether any form of tuberculin is likely to be capable of destroying tuberculosis or not. But the tuberculin problem marks an important stage in the world's battle against bacteria, and it must be remembered that at the time Koch published his discovery, not even Behring's serum against diphtheria had been discovered. True, Koch was not the first : the history of bacteriology begins with Leeuwenhœck who, at the end of the seventeenth century, was the first to see under his magnifying glass the smallest of all organisms from which so many diseases come.

Koch, however, was the first to find a specific bacillus as the originator of a particular disease, and to prove its identity without possibility of error. Since then, many of these formerly invisible enemies of mankind have been brought under the microscope. A great hunt was started, and is still going on, every episode of which is an interesting chapter in science, and often reveals a heroism on the part of some scholar greater than that of many a world-famous hero. Major Ronald Ross rejoiced greatly when, after endless researches, he had at last found the organism responsible for malaria, a disease to whose poison millions had succumbed. Many other investigators have experienced similar delight : Pasteur, for example, who though he did not entirely stamp out rabies, yet reduced it very considerably, and whose name should be placed at the head of this list as having recognised microbes as enemies ; Behring, to whom we owe the diphtheria serum ; David Bruce, who with unexampled heroism discovered the nature of sleeping sickness, the secret of the tsetse fly ; Walter Reed, who conquered

yellow fever ; Paul Ehrlich, who with incomparable tenacity made preparation after preparation and finally found in his six hundred and sixtieth that which is now called salvarsan—the deadly enemy of the pale spirilla which breed lues, that terrible scourge of mankind.

Other microbe hunters are sure to follow these, for the field is by no means exhausted. We know of many diseases which are certainly caused by as yet unidentified bacteria ; but we hesitate to enumerate them, as any day may see their number diminished and the anonymity of some bacillus destroyed.

Triumph over a disease and knowledge of the micro-organism which causes it are, however, not always the same thing. The tuberculosis bacillus already mentioned is a case in point ; it has been known for decades, but has only indirectly helped in the battle against the disease—the various tuberculins, though useful, are not absolutely reliable. On the other hand, it is not known what micro-organism causes smallpox, though it is certainly a bacillus or something of the kind ; but nevertheless inoculation against smallpox is something on which one can rely, an absolute protection giving immunity for some years. In the year 1905 Schaudinn found the spirochæte which cause syphilis and which are so pale and transparent that they could not be perceived at all except under an ultra-microscope. In spite of this discovery there is no such thing as a serum treatment or inoculation against the disease, though it need hardly be mentioned that great efforts have been made to discover such treatment. Just as in the case of the discovery of other kinds of bacteria there are obstacles

here which seem invincible and will remain so, until some genius conceives an idea which will overcome them.

Those bacteria or other micro-organisms to which the human body is indifferent or which may even be useful for human purposes, will not be discussed here. Only that large number will be treated of which it is known that they are enemies of human and animal bodies. This enmity is shown in the first place by the fact that they induce certain diseases with very characteristic symptoms. The typhoid bacillus, for example, produces typhoid, a dangerous disease in the course of which certain ulcers are formed in the intestines which may bleed or perforate the tissues. Then there is the originator of erysipelas—this penetrates the skin through the tiniest lesion, causing the well-known inflammation—the reddening and swelling, which is inclined to spread and may often take on very dangerous dimensions.

But these dangerous—one might almost call them localised—in any case always characteristic, injuries are not the only ones which it is within the power of bacteria to call forth. Other and very serious harm may be done by the poisons produced by the bacteria themselves. This is certainly the most interesting part of bacteriology and reveals conditions which are very strange and in many cases still obscure. Someone is taken ill with diphtheria; the dangerous greyish layers on the membranes of the throat have been present, but they have disappeared and the patient is convalescent. Though he has been forbidden to do so, he sits up in bed and falls back dead. An extraordinary occurrence, only explicable by the poisoning of the heart caused by the diphtheria bacilli.

These bacteriological poisons have been steadily investigated ever since bacteriology has existed, and it is known that they are of two kinds. Bacteria, simple organisms as they are, have their vital functions, their metabolism, they absorb and reject substances, and in many cases it is these excretions which are toxic. In such cases, then, the poison comes only from the excretions and not from the bacteria themselves. If anyone, for example, becomes infected through a small wound by tetanus bacilli he acquires the terrible illness known as tetanus or lock-jaw. But what causes the illness is the poison from the excretions of the bacillus, and it is possible to obtain the poison from cultures of the tetanus bacilli and with this to induce the disease in animals, i.e. without infecting them with the bacillus itself.

With other bacilli again it is different. They do not produce poison, but are themselves poisonous. Their bodies, that is (which are only visible under the microscope), are poisonous. And when they become decomposed in consequence of the defence organisms contained in the bodies of the people infected by them, their poisonous effect becomes perceptible. The enfeebled body of the patient must now do battle with the poison represented by the bodies of the bacilli it has already killed. Typhoid and cholera bacilli are examples of this.

The difficulties in the way of discovering all these many possibilities are easily conceivable. It is not even always possible to show that a bacterial poison (or for that matter any kind of poison) is present in the body. The poisonous effect depends, as was stated earlier in this book, on a chemical affinity between

poison and body cell ; the result of their attraction to one another is the poisoning, and any substance having no affinity to one or other of the group of body cells has no poisonous effect. All treatment of infectious diseases with chemicals is founded on such affinities. Salvarsan destroys the spirochæte, the cause of syphilis, because spirochæte and salvarsan are chemically attracted to each other and then remain together, one might say like an insect impaled on a pin—to use a simile of Paul Ehrlich's. Whether this attraction is called affinity or by some other name, in its effect on a human being, i.e. with regard to the purpose desired by the human being, it is something entirely different—it is disinfection, cure, war against epidemics on a large or on a small scale, in any case a great benefit.

Still more wonderful is the work done by the organism itself, that is to say the organism in which the bacteria produce their poison, either directly or by their decomposition. The organism which is attacked defends itself fiercely and in a most mysterious manner. Whole armies rise up in the blood of such persons and attack the enemy—anti-toxins are formed to carry on the battle with the bacterial poison. It is a desperate battle and one does not always know how it will end. Men do their best to direct the battle with the scientific knowledge at their command. Sometimes science fails, but sometimes it is the human being wielding scientific weapons who fails, and then there happens a catastrophe such as that in Lübeck.

CHAPTER XXIV

MISCELLANEOUS

When the generals commanding the poison armies —arsenic, strychnine, hydro-cyanic acid, curare, fly-agaric, opium, hashish, cocaine, atropine and some others—have been enumerated, this by no means exhausts the tale of poisons, every one of which can and has proved that it can kill and destroy. Some poisons seldom met with by doctors and criminologists of the present day were much better known in former times ; some of them now barely known may become of sudden importance. There are very large numbers of them, and new poisons are always being added to their number—found by chance, manufactured for some useful purpose by the industries, or applied by mistake or with intention.

A poison, now of little significance, but once of the greatest importance, is the hemlock. It was used in Ancient Greece for carrying out the extreme penalty. Socrates was accused of perverting youth and condemned to empty a cup of hemlock, like many others before and after him. The actuating poison of the hemlock plant is called coniine and is found in the leaves, stems and seeds of the plant ; in human beings it produces stomach and intestinal disturbance, retards the pulse and paralyses the respiratory organs. Hemlock has been known mistakenly to have been taken for parsley and thus caused poisoning, and both suicides and murderers have made use of the plant. Many animals are more or less insensitive to this poison, for

example, larks and quails ; horses, too, can tolerate a few handfuls of the herb, but they are less insensitive to the cowbane, or water-hemlock.

A larger part in the murders by poison which happened so frequently in ancient times and in the Middle Ages was played by wolfsbane (aconite) the active poisonous principle of which is aconitine. In the famous poison garden belonging to Attilus, the last King of Pergamon, who died in 132 B.C., wolfsbane was to be found, that plant of which Theophrastus wrote that it could be so prepared as to produce a lethal effect at a stated time, that is, after two, after three, or even after six months. In Ancient Rome aconite was very popular for poisonings. A large number of the many murders of relatives, political murders, murders from all causes, were committed with the help of wolfsbane. Ovid called aconite the stepmother's poison (which was very characteristic of those days), and Juvenal made his meaning quite as clear when he said that aconite was only drunk out of cups set with jewels, no poor man need fear this poison. The number of these misdeeds must have been very large, for—true, it was somewhat later, in the year A.D. 117—the emperor Trajan issued a decree forbidding the planting of wolfsbane in domestic gardens ; a very significant symptom of a time in which everyone seemed afraid of being poisoned.

The surgeon Caravita, in the Rome of the sixteenth century, is said to have discovered an oil which, when rubbed on the skin, was an excellent antidote against poison. Pope Clement VII, therefore, permitted the following experiment : two robbers who had been condemned to death by the gallows were given some wolfsbane tubers baked in a kind of bread. One of

the robbers was immediately rubbed with Caravita's oil ; he showed severe symptoms of poisoning, but recovered completely after three days. The other robber was given less of the wolfsbane, but was not treated with the oil ; he died in torment after a few hours.

This plant with its large blue blossoms, the tubers and leaves of which contain the poison, is well known in Central Europe, and it used to play some part in medicine. The symptoms of aconitine poisoning appear soon after it has been consumed. They are nausea, vomiting, cold sweat, difficulties in speaking and swallowing, lassitude in the first place ; later spasmodic irregular respiration and a retarded pulse. Death occurs by suffocation, and artificial respiration is sometimes of use. Browsing animals avoid this plant. If by chance they consume wolfsbane they fall ill, their milk dries up, they fall groaning to the ground, their body temperature is excessively low and sometimes they die.

Some other things that grow in gardens, fields or forests must be mentioned here. Very few people know that the lily-of-the-valley, our delightful spring flower, contains a very strong poison. A child who drank a glass of water which had held some lilies-of-the-valley lost consciousness and died soon after. It is sometimes used as a cardiac remedy in medicine.

But a much stronger poison and a much stronger cardiac remedy is provided by the red foxglove—digitalis—the sovereign cardiac remedy in the pharmacopœia, which strangely enough is said first to have been brought to the Continent by Irish monks. In any case it was already contained in prescriptions of the early Middle Ages, principally for external application. The Englishman, William Withering, was the

first—towards the end of the eighteenth century—to call attention to the great importance of the digitalis plant for internal medicine. But it is probable that even before his time doctors knew that the leaves of this plant produced a good remedy against dropsy. However, this may be, it is Withering's name which is always connected with the introduction of digitalis into medicine, where it has remained one of its greatest treasures.

The red foxglove is to be found in the mountain woods of Western Europe where it is very common, but many a peasant garden in the plains is also decorated by these characteristic blossoms ; in July whole fields of blossoming digitalis may be seen where it is specially cultivated for medical purposes. The actuating principle and poison are principally contained in the leaves. This is digitalin, and the still stronger digitoxin. In medicine infusions are made of the leaves (in much the same way as tea), or in more recent times special preparations are used, on account of their uniform effect. The first of these was digalen, as prescribed by Clotta in the year 1904. The effect of digitalis is very characteristic and reliable. Its principal use is to retard the pulse and make it stronger and fuller. This strengthens the whole circulation and relieves at least in part the congestion of the veins, as it regulates the work of the heart which ceases to pump large quantities into already congested vessels ; with the relief of the blood congestion, the water which has been forced into the tissues finds its way back and can be eliminated.

This is the inestimable value of treatment by digitalis, but it needs great care. It must cease in time, as the poisonous effect is cumulative and other-

wise leads to digitalis poisoning. The poisoning is first shown by abnormal retardation of the pulse, then the discharge of urine ceases, the patient faints and finally the heart ceases action. Such poisoning as a result of medical treatment used to be very common. Now great care is taken to prevent cumulative poisonous effects.

Among the domestic plants which are poisonous must be reckoned the herb Paris, the leaves of which are particularly poisonous; then the hazelwort, which we use for mice and rat poison, but which is sometimes used for other purposes, and also the cuckoo-pint, which not even cows tolerate. There have been cases of poisoning by daphne, some of them fatal; even a few berries may cause severe poisoning. As regards the yew, even the Ancient Greeks and Romans knew that it was poisonous, about a pound of its leaves can kill a horse, though blackbirds and thrushes eat yew berries without taking harm. The meadow-saffron, which appears so plentifully in September, contains a substance which formerly made the blossoms much sought after as a remedy for gout. Veterinary surgeons know that cows are often poisoned by this flower, and the poison is very dangerous to human beings.

And many other plants should be mentioned. There is, for example, a poison plant which grows in Bohemia called *adonis vernalis*, known also to doctors as a cardiac remedy; also the marsh-marigolds, which are even avoided by grazing horses; the black hellebore (or Christmas rose) is sometimes mistaken for rhubarb—a mistake which is very significant, as the poisonous effects may be very serious; the larkspur, a few grams of the seeds of which can kill a dog; the

well-known Indian berries, seeds of creepers used for killing fish and producing in human beings severe intestinal disturbance, convulsions, delirium and sometimes death ; celandine, which is only poisonous when it is fresh, but then produces very serious enfeeblement of the heart ; the corn-cockle, the seeds of which are tolerated neither by humans nor by animals—they produce in chickens conditions reminiscent of chicken cholera, and even pigs and cows can be killed by them.

Another poisonous plant is the rue, often found in Southern Europe and formerly widely used in pharmacies, and still more in households ; to this family belongs also the jaborandi, native to Brazil, which contains in its leaves the very strong poison pilocarpine. Pilocarpine has effects which are the opposite of those caused by the atropine in belladonna—it induces cramps of the stomach and intestines, first excites and then paralyses the heart, stimulates all the glands, especially the perspiratory glands, to greater activity and is therefore useful in medicine. A plant that may not even be touched is the poison-sumac, which has been transplanted from its North American home to our own gardens ; any contact with a branch or a leaf causes severe inflammation of the skin, which may not appear until after one or two days, and if anyone is sensitive such contact may cause him a long period of suffering.

The blue, yellow and white lupins, which are planted in many parts of Europe and are treasured for their valuable nutritious qualities, contain, though not always, a poison which, taken for any length of time, produces inflammation of the liver and the kidneys. The detoxication of lupins, therefore, the elimination of their bitter principle, is one of the tasks

of agricultural chemistry. Poisoning by means of laburnam has often occurred—a few blossoms or a few grains of the seed can cause severe illness ; reports have often been given of poisoning caused by the consumption of wild melons ; then there is another kind of melon, the colocynth, whose round white globes can be used in medicine as a purge, but if too much is taken the effects are far beyond those desired.

Vermouth contains a poisonous volatile oil ; the damage done by absinthe has long been well known. In Southern Europe the oleander has often led to poisoning (sometimes desired by the victim) and the poisonous oleander blossoms or leaves have often been taken, particularly for the purpose of producing symptoms of illness in order that the victim may be released from compulsory military service. If the twig-ends are boiled and consumed, cardiac symptoms are produced. There are other plants often considered harmless which on occasion are nothing of the kind.

In May, 1933, two little girls—sisters—living near Ellwangen fell very ill after eating sorrel. Both became blind and then died. Poisoning by means of sorrel has often been mentioned in medical literature. The symptoms are not always the same—there is nausea and vomiting, with abdominal pains, and the same phenomena as are found in inflammation of the kidney. Mass poisoning of animals which have eaten sorrel when grazing has also been known. It has, for instance, been reported that of three hundred sheep forty died from intestinal disturbance after having grazed off a sorrel meadow. The causes of these poisonings are obscure. It is unlikely that, as some people assume, injury to health is caused by the fairly large quantity of oxalate of lime which is con-

tained by sorrel. Possibly the sorrel poisonings are caused by the presence of an alkaloid, a poison which has not yet been isolated, possibly by the presence of fungi on these plants.

But all this is only a very small selection, the series of poisonous plants is practically illimitable. One need only think of the innumerable varieties found in the Tropics, primeval forests and jungles, threatening the lives of men and animals.

It has several times been pointed out that there is a very close connection between therapy and toxicology. In the vegetable kingdom there are many examples of this, as there are both in inorganic and organic chemistry. Cinchona bark and the quinine extracted from it are now indispensable in medicine—it is excellent in the treatment of fever, particularly of malaria. And yet quinine poisoning must be feared and great care must be taken to avoid over-dosage. Dogs can be killed by 2 grams of quinine. Unconsciousness, cramps, retarded pulse, are the severe symptoms of quinine poisoning in human beings, disturbances of eyesight and hearing are the milder forms. Fever accompanied by a delirient condition can also be produced by quinine—so can rashes on the skin.

The cases of santonine poisoning are very interesting. One has been described in detail by Professor Sury in Basle. The mother of a perfectly healthy little boy of three and a half thought that he had worms, as he had some of the characteristic symptoms. She therefore bought some santonine pastilles and gave them to the child, in all about ten or twelve of them in the course of forty hours. When the child became restless and his face swollen, a doctor was called who

diagnosed inflammation of the kidneys. The child died after four days in hospital, where the diagnosis "inflammation of the kidneys" was confirmed and, moreover, santonine was found in the urine. Santonine is derived from wormseed, from the *flores cinæ*, and is often used against worms; a single dose for a child is about a fortieth to a twentieth of a gram, for a child three years old the highest permissible dose would be four times a day one-fiftieth of a gram. The analysis of the pastilles which the child had received showed that each of them contained four- to eight-thousandths of a gram, that is a very small dose, so that the child had altogether taken in the course of nearly two days eight- or nine-hundredths of a gram of santonine. On the other hand, although there was no doubt about the diagnosis, the symptoms of santonine poisoning had not been very clear. Santonine poisoning is rare, but a certain number of cases is known. Its most characteristic feature is that the victims complain of seeing everything a yellow colour. This and other symptoms of the brain, such as headache, giddiness, stupor, twitching are usual; nothing had been known of kidney disturbance or still less, as in this case, acute inflammation of the kidneys in consequence of santonine poisoning. As there was no doubt that the child in Sury's case nevertheless died of santonine poisoning, Sury assumed that it must have been peculiarly sensitive to this poison—a phenomenon very often met with in the history of poisons altogether.

It is comprehensible that professional tea-tasters who daily consume very many quarts of tea, are finally poisoned and fall ill from the substances which tea contains. It is, however, harder to understand the acute sensitiveness shown by some people towards

chocolate—but there are people who cannot tolerate it at all.

The War made us more closely acquainted with saccharine. That too much of this can be injurious is shown by the case of a nine-year-old boy reported by a doctor in Bamberg. The boy, who seems to have been particularly greedy, had dissolved two hundred saccharine tablets in a quart of water and had drunk this off. In consequence he developed typical delirium and his consciousness was severely disturbed. In his delirium he saw visions and was very restless ; this was followed by virulent nettle-rash with large blisters, and after that he was cured of his saccharine poisoning.

How difficult it often is to find a right diagnosis, and how often small, hardly perceptible, incidents suffice to endanger human health is shown by an event which happened in the Friedrich Children's Hospital in Berlin. One night five babies were suddenly taken ill there. The first thing that the nurse noticed was a strange blue colouring in their skin. The children, however, seemed to be feeling quite well and so it was thought that they were probably only cold and would be all right in the morning. When morning came, however, the symptoms were more significant, the children's skin was a bluish green, their breathing was worse, and, when finally they were attacked by cramps in their arms and legs and by vomiting, the idea necessarily arose that these five babies had in some way been poisoned. But what could the poison be? It was at first very difficult to find the source. Three of the children were breast-fed, two of them were being brought up by hand. It could not, then, be due to their food, nor could it be gas poisoning, as in that case they would not have been

the only victims. When these little patients were examined more closely, black marks were discovered on the heels of some of the children, which could not be removed either by soap or by petrol. This black colouring was from stamp dye. It was then discovered that the five children had been freshly clad the evening before and had been given diapers which were quite new. They had, it is true, been washed, but had then been stamped with the mark of the hospital. The fresh dye from the stamp had been transferred from the linen to the children's skin and some of the colour had been absorbed by their organisms. A chemical analysis of the dye, which had a distinct smell of bitter almonds, revealed the poison which had so harmed the children. It was nitrobenzene, so-called oil of mirbane, which is a very virulent poison, possessing the property of destroying blood. It is the destruction of the blood and the blood's colouring matter which causes that strange discoloration of the skin which had been the first symptom to be observed in the babies ; under the appropriate treatment the children soon recovered.

Formerly, carbolic acid accounted for a large proportion of the figures in poison statistics. When carbolic acid was introduced into surgery by the application of Lister's antiseptic method, this was an epoch-making event. Man now possessed a means of doing effective battle with the bacteria which had been recognised as the enemies of man and of surgical wounds. Nor was it used at all sparingly. The surgeons in the 'eighties of last century worked in a kind of carbolic mist, the surface prepared for operation was covered with cloths soaked in carbolic, and the wounds themselves were lavishly washed with it. It

was, of course, soon discovered that carbolic acid is anything but an indifferent substance, and that allowing carbolic acid even to trickle over large wounds could cause severe poisoning. But the greatest danger of all was the bottle of carbolic acid itself, which gave rise to many a tragic event and which was often resorted to by suicides. The lethal dose is not always the same ; sometimes a spoonful or even less is sufficient. The effect may ensue very rapidly—unconsciousness may be followed by death within a few minutes. Carbolic acid destroys the body cells by precipitating their albumen ; when the poison is not so rapid in its action as just described, it causes inflammation of the kidneys and intestines. It should be noted that one must beware of compresses with carbolic acid, as the skin and the tissues at the place of application become mortified. Carbolic acid plays a very small part in present-day medicine—the antiseptic method has been replaced by the aseptic, and washing one's hands, boiling of instruments, careful cleansing of the field of operation, have succeeded carbolic. Carbolic acid should be banned absolutely from private households and their medicine chests.

Poisoning by means of lysol is more frequent, even at the present day. For a time this was a very frequent method of suicide, especially among women and girls in their despair. Lysol contains cresols, which are certainly no less poisonous than carbolic acid. The effects are similar ; besides the local consequences, at first there is sometimes delirium, then unconsciousness, suspended pulse, in cases of long poisonous influence inflammation of the kidneys and damage to the liver, which take a long time to

heal. The treatment in cases of lysol poisoning is much the same as in carbolic acid poisoning : with great care, as the mucous membranes are injured by corrosion, the doctor applies stomach lavages and is liberal with the water ; it is important to give a great deal of oil, the best for the purpose probably being fluid paraffin, of which about half a pint should be taken.

If poisoning from carbolic acid may be considered as belonging to the Past in medicine, barium poisoning must on the other hand be described as a recent development. It is connected with the discovery of X-rays. When a patient's stomach and intestines are to be X-rayed he has to swallow a concoction of something which the rays cannot penetrate—mostly this meal consists of the perfectly harmless barium sulphate. Unfortunately, however, it has happened that the patient has received in error either the deadly barium nitrate or some other soluble barium salt instead of the insoluble and therefore harmless sulphate. There have also been cases where such barium salts have been taken in error for bicarbonate of soda or common salt. Even the X-rays themselves may be looked upon as a poison—a blood-destroying poison—as is proved by the " X-ray hang-over " which is felt by some patients and which is just as unpleasant as other disturbances of the whole organism caused by poisoning.

Another blood poison is potassium chloride, well known as a gargle. (The powder, by the way, has another property which commands respect—it can explode.) The symptoms of poisoning by potassium chloride are : terrible thirst, nausea, discoloration of the skin, blanching of the red blood corpuscles, very great increase in the number of white blood corpuscles,

general weakness, rattling respiration ; consciousness may be retained till death ensues. Unfortunate errors have led to many accidental poisonings from this cause. Potassium chloride has also been used for suicide, as, for example, in the case of the famous Viennese actor at the Hofburg theatre : Mitterwurzer. For a short time in that period it was the " fashion " to commit suicide by using potassium chloride. It has often been noted that suicide methods are subject to such fluctuations of " fashion." Thus in 1930 a doctor at the Rochus Hospital in Budapest reported that suicides with aspirin were exceedingly frequent in Hungary. In the year 1927 the ambulance service had been requisitioned in no less than 230 such cases ; in the next two years the figures were similar. In the hospital just named 136 cases of poisoning from this cause were registered in the year 1929, one of the cases ending fatally.

Chlorine and iodine are poisonous—it has long been known that there are a great many people who cannot tolerate iodoform even in the smallest quantities. Fluorine is also poisonous ; there has even been one case of suicide by means of fluorine. In fact there is an endless series of poisonous substances. There are very few things which, taken in sufficiently large quantities, do not produce injury to health and cannot be used for suicidal purposes. In medicaments these properties are, of course, more apparent. Moreover, the very nature of medicaments presupposes an affinity to body-cells, that is, an effect either on the whole organism or certain parts of it. This is one reason why the history and science of poisoning is an inexhaustible subject.

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